UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

THE EPHEMERIS

1964

Prepared by
Nautical Almanac Office
United States Naval Observatory

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1964

UNITED STATES
DEPARTMENT OF THE INTERIOR
Stewart L. Udall, Secretary
BUREAU OF LAND MANAGEMENT
Charles H. Stoddard, Director

✦

EPHEMERIS OF THE SUN, POLARIS

AND

OTHER SELECTED STARS

WITH COMPANION DATA AND TABLES

FOR THE YEAR

1964

A Supplement to the Manual of Instruction for the Survey of the Public Lands
of the United States

FIFTY-FIFTH EDITION

Prepared by Nautical Almanac Office
United States Naval Observatory

March 3, 1849

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PREFACE

The arrangement of the astronomical data herein conforms to the methods and examples for the determination of time, latitude, and azimuth, practiced by the cadastral engineers of the Bureau of Land Management. These practices are described in the Manual of Instructions for the Survey of the Public Lands of the United States.

The methods long in use have been developed for the best operation of the improved solar transit, in combination with observations on the sun, Polaris, and the brighter equatorial stars, for the determination and verification of time, latitude, and azimuth. In this practice, the data for the *sun* are required in terms of daily *apparent positions* for the Greenwich meridian; for all *stellar* positions in terms of the Greenwich meridian, *mean time*, and *mean time intervals*.

The apparent time of sunrise and of sunset, the refractions in polar distance, and the companion trigonometric tables and formulas employed in these methods, are tabulated in the Standard Field Tables of the Bureau of Land Management.

Other Technical Publications

The Superintendent of Documents, Government Printing Office, Washington 25, D.C., has for sale to the public at current cost of printing the following technical publications of the Bureau of Land Management.

The Manual of Instructions for the Survey of the Public Lands of the United States, 1947.

Standard Field Tables, 1956 (a supplement to the Manual of Surveying Instructions); contains traverse tables; stadia coefficients; 5-place natural and 6-place logarithmic sines, cosines, tangents, and cotangents; 6-place logarithms of numbers; and other tables and data of particular application in land surveying practice.

The Ephemeris, published annually.

Restoration of Lost or Obliterated Corners and Subdivision of Sections, 1952, reprint 1955; a compendium of the rules that are applicable within the area of the United States rectangular surveys, for the guidance of county and other local surveyors, with explanation of the methods relating to retracements.

AT GREENWICH APPARENT NOON							POLARIS FOR THE MERIDIAN OF GREENWICH , CIVIL DATE AND MEAN TIME		
Date		THE SUN'S			Time Semi-diameter Passing Mer.	Equation of Time , Add to Apparent Time	Upper Culmination	Elongation Lat . 40°	Declination
		Apparent Declination	Diff . for 1 Hour	Semi-diameter					
JANUARY, 1964									
		° ′ ″	″	′ ″	s	m s	h m	h m	° ′ +89 06 ″
Wed.	1	S23 03 30.6	+11.60	16 17.54	71	3 14.33	7 17.1 P.M.	W.E. 1 17.0 A.M.	02.84
Thur.	2	22 58 38.3	12.75	16 17.54	71	3 42.64	7 13.2	1 13.1	03.04
Fri.	3	22 53 18.7	13.89	16 17.54	71	4 10.64	7 09.2	1 09.1	03.21
Sat.	4	22 47 31.7	15.03	16 17.54	71	4 38.29	7 05.3	1 05.2	03.36
Sun.	5	22 41 17.5	16.15	16 17.52	71	5 05.57	7 01.3	1 01.2	03.48
Mon.	6	22 34 36.3	17.27	16 17.50	71	5 32.45	6 57.4	0 57.2	03.60
Tues.	7	22 27 28.3	18.39	16 17.48	71	5 58.91	6 53.4	0 53.3	03.70
Wed.	8	22 19 53.7	19.49	16 17.45	71	6 24.90	6 49.4	0 49.3	03.80
Thur.	9	22 11 52.7	20.59	16 17.42	71	6 50.42	6 45.5	0 45.4	03.91
Fri.	10	22 03 25.6	21.67	16 17.38	70	7 15.42	6 41.5	0 41.4	04.02
Sat.	11	21 54 32.5	22.74	16 17.34	70	7 39.88	6 37.6	0 37.5	04.13
Sun.	12	21 45 13.9	23.81	16 17.29	70	8 03.79	6 33.6	0 33.5	04.25
Mon.	13	21 35 29.8	24.86	16 17.24	70	8 27.09	6 29.7	0 29.6	04.38
Tues.	14	21 25 20.7	25.90	16 17.19	70	8 49.79	6 25.7	0 25.6	04.50
Wed.	15	21 14 46.7	26.92	16 17.14	70	9 11.84	6 21.8	0 21.7	04.62
Thur.	16	21 03 48.3	27.94	16 17.08	70	9 33.24	6 17.8	0 17.7	04.73
Fri.	17	20 52 25.7	28.94	16 17.01	70	9 53.95	6 13.9	0 13.8	04.82
Sat.	18	20 40 39.2	29.93	16 16.94	70	10 13.94	6 09.9	0 09.8	04.88
Sun.	19	20 28 29.2	30.90	16 16.87	70	10 33.21	6 05.9	0 05.8	04.93
Mon.	20	20 15 56.0	31.86	16 16.80	70	10 51.74	6 02.0	0 01.9 A.M. 11 57.9 P.M.	04.95
Tues.	21	20 02 59.9	32.81	16 16.72	70	11 09.50	5 58.0	11 54.0	04.96
Wed.	22	19 49 41.3	33.74	16 16.63	69	11 26.49	5 54.1	11 50.0	04.97
Thur.	23	19 36 00.6	34.65	16 16.54	69	11 42.69	5 50.1	11 46.1	04.98
Fri.	24	19 21 58.1	35.55	16 16.45	69	11 58.09	5 46.2	11 42.1	05.00
Sat.	25	19 07 34.3	36.43	16 16.35	69	12 12.69	5 42.2	11 38.2	05.04
Sun.	26	18 52 49.5	37.30	16 16.24	69	12 26.49	5 38.3	11 34.2	05.09
Mon.	27	18 37 44.0	38.15	16 16.13	69	12 39.47	5 34.3	11 30.3	05.15
Tues.	28	18 22 18.4	38.98	16 16.02	69	12 51.63	5 30.4	11 26.3	05.20
Wed.	29	18 06 32.9	39.80	16 15.89	69	13 02.99	5 26.4	11 22.3	05.23
Thur.	30	17 50 28.0	40.60	16 15.76	69	13 13.53	5 22.4	11 18.4	05.23
Fri.	31	S17 34 03.9	+41.39	16 15.63	68	13 23.27	5 18.5 P.M.	W.E. 11 14.4 P.M.	05.22
FEBRUARY, 1964									
Sat.	1	S17 17 21.2	+42.16	16 15.49	68	13 32.20	5 14.5 P.M.	W.E. 11 10.5 P.M.	05.17
Sun.	2	17 00 20.1	42.92	16 15.34	68	13 40.32	5 10.6	11 06.5	05.11
Mon.	3	16 43 01.0	43.66	16 15.19	68	13 47.64	5 06.6	11 02.6	05.04
Tues.	4	16 25 24.4	44.38	16 15.04	68	13 54.16	5 02.7	10 58.6	04.96
Wed.	5	16 07 30.7	45.09	16 14.88	68	13 59.89	4 58.7	10 54.7	04.89
Thur.	6	15 49 20.2	45.78	16 14.71	68	14 04.83	4 54.8	10 50.7	04.81
Fri.	7	15 30 53.4	46.45	16 14.54	68	14 08.96	4 50.8	10 46.7	04.75
Sat.	8	15 12 10.7	47.10	16 14.37	68	14 12.33	4 46.9	10 42.8	04.69
Sun.	9	14 53 12.4	47.74	16 14.20	67	14 14.90	4 42.9	10 38.8	04.63
Mon.	10	14 33 59.1	48.36	16 14.02	67	14 16.70	4 38.9	10 34.9	04.58
Tues.	11	14 14 31.2	48.96	16 13.84	67	14 17.73	4 35.0	10 30.9	04.52
Wed.	12	13 54 49.0	49.55	16 13.65	67	14 17.99	4 31.0	10 27.0	04.45
Thur.	13	13 34 53.0	50.11	16 13.47	67	14 17.50	4 27.1	10 23.0	04.37
Fri.	14	13 14 43.7	50.66	16 13.28	67	14 16.24	4 23.1	10 19.1	04.27
Sat.	15	12 54 21.4	51.19	16 13.09	67	14 14.25	4 19.2	10 15.1	04.14
Sun.	16	S12 33 46.6	+51.70	16 12.90	67	14 11.50	4 15.2 P.M.	W.E. 10 11.2 P.M.	04.00

The sign + prefixed to the hourly change of declination indicates that { north / south } declinations are { increasing / decreasing .

The sign – prefixed to the hourly change of declination indicates that { south / north } declinations are { increasing / decreasing .

AT GREENWICH APPARENT NOON						POLARIS FOR THE MERIDIAN OF GREENWICH , CIVIL DATE AND MEAN TIME		
	THE SUN'S							
Date	Apparent Declination	Diff . for 1 Hour	Semi - diam - eter	Time Semi-diam-eter Pass-ing Mer.	Equation of Time , Add to Apparent Time	Upper Cul - mination	Elongation Lat . 40°	Decli - nation
FEBRUARY, 1964								
	° ′ ″	″	′ ″	s	m s	h m	h m	° ′ +89 05 ″
Sun. 16	S12 33 46.6	+51.70	16 12.90	67	14 11.50	4 15.2 P.M.	W.E. 10 11.2 P.M.	64.00
Mon. 17	12 12 59.8	52.19	16 12.70	67	14 08.02	4 11.3	10 07.2	63.83
Tues. 18	11 52 01.3	52.67	16 12.50	67	14 03.82	4 07.3	10 03.2	63.67
Wed. 19	11 30 51.5	53.13	16 12.30	66	13 58.91	4 03.4	9 59.3	63.50
Thur. 20	11 09 31.1	53.57	16 12.10	66	13 53.29	3 59.4	9 55.3	63.35
Fri. 21	10 48 00.2	53.99	16 11.89	66	13 46.98	3 55.5	9 51.4	63.21
Sat. 22	10 26 19.3	54.40	16 11.68	66	13 40.01	3 51.5	9 47.4	63.08
Sun. 23	10 04 29.0	54.79	16 11.47	66	13 32.37	3 47.6	9 43.5	62.96
Mon. 24	9 42 29.5	55.16	16 11.25	66	13 24.11	3 43.6	9 39.5	62.84
Tues. 25	9 20 21.4	55.51	16 11.03	66	13 15.22	3 39.7	9 35.6	62.71
Wed. 26	8 58 04.9	55.85	16 10.80	66	13 05.74	3 35.7	9 31.6	62.56
Thur. 27	8 35 40.6	56.17	16 10.57	66	12 55.67	3 31.7	9 27.7	62.38
Fri. 28	8 13 08.6	56.48	16 10.34	66	12 45.06	3 27.8	9 23.7	62.18
Sat. 29	S 7 50 29.5	+56.77	16 10.10	65	12 33.91	3 23.8 P.M.	W.E. 9 19.8 P.M.	61.97
MARCH, 1964								
Sun. 1	S 7 27 43.5	+57.05	16 09.86	65	12 22.25	3 19.9 P.M.	W.E. 9 15.8 P.M.	61.74
Mon. 2	7 04 51.1	57.31	16 09.61	65	12 10.10	3 15.9	9 11.9	61.50
Tues. 3	6 41 52.6	57.56	16 09.36	65	11 57.48	3 12.0	9 07.9	61.27
Wed. 4	6 18 48.4	57.79	16 09.11	65	11 44.41	3 08.0	9 04.0	61.04
Thur. 5	5 55 38.9	58.00	16 08.86	65	11 30.91	3 04.1	9 00.0	60.81
Fri. 6	5 32 24.5	58.20	16 08.61	65	11 17.00	3 00.2	8 56.1	60.60
Sat. 7	5 09 05.5	58.38	16 08.35	65	11 02.69	2 56.2	8 52.1	60.39
Sun. 8	4 45 42.4	58.54	16 08.09	65	10 48.02	2 52.3	8 48.2	60.18
Mon. 9	4 22 15.5	58.69	16 07.83	65	10 33.00	2 48.3	8 44.3	59.98
Tues. 10	3 58 45.1	58.83	16 07.56	65	10 17.64	2 44.4	8 40.3	59.78
Wed. 11	3 35 11.8	58.94	16 07.30	65	10 01.96	2 40.4	8 36.4	59.56
Thur. 12	3 11 35.9	59.04	16 07.04	65	9 45.98	2 36.5	8 32.4	59.33
Fri. 13	2 47 57.7	59.13	16 06.77	65	9 29.72	2 32.5	8 28.5	59.08
Sat. 14	2 24 17.6	59.20	16 06.51	65	9 13.20	2 28.6	8 24.5	58.80
Sun. 15	2 00 36.2	59.25	16 06.24	65	8 56.42	2 24.6	8 20.6	58.51
Mon. 16	1 36 53.7	59.29	16 05.98	65	8 39.41	2 20.7	8 16.6	58.21
Tues. 17	1 13 10.5	59.30	16 05.71	65	8 22.19	2 16.7	8 12.7	57.92
Wed. 18	0 49 27.1	59.31	16 05.45	65	8 04.75	2 12.8	8 08.7	57.64
Thur. 19	0 25 43.7	59.29	16 05.19	65	7 47.14	2 08.9	8 04.8	57.37
Fri. 20	S 0 02 00.9	59.27	16 04.92	65	7 29.37	2 04.9	8 00.9	57.12
Sat. 21	N 0 21 41.0	59.22	16 04.65	65	7 11.44	2 01.0	7 56.9	56.88
Sun. 22	0 45 21.7	59.16	16 04.39	65	6 53.40	1 57.0	7 53.0	56.65
Mon. 23	1 09 00.7	59.09	16 04.12	65	6 35.25	1 53.1	7 49.0	56.41
Tues. 24	1 32 37.8	59.00	16 03.85	64	6 17.03	1 49.1	7 45.1	56.16
Wed. 25	1 56 12.5	58.89	16 03.58	64	5 58.75	1 45.2	7 41.1	55.88
Thur. 26	2 19 44.6	58.77	16 03.31	64	5 40.44	1 41.3	7 37.2	55.59
Fri. 27	2 43 13.7	58.64	16 03.03	64	5 22.11	1 37.3	7 33.3	55.28
Sat. 28	3 06 39.5	58.50	16 02.76	64	5 03.81	1 33.4	7 29.3	54.96
Sun. 29	3 30 01.6	58.34	16 02.48	65	4 45.54	1 29.4	7 25.4	54.63
Mon. 30	3 53 19.8	58.17	16 02.20	65	4 27.34	1 25.5	7 21.4	54.30
Tues. 31	4 16 33.7	57.98	16 01.92	64	4 09.21	1 21.6	7 17.5	53.98
Wed. 32	N 4 39 43.0	+57.78	16 01.64	64	3 51.19	1 17.6 P.M.	W.E. 7 13.6 P.M.	53.67

The sign + prefixed to the hourly change of declination indicates that { north / south } declinations are { increasing. / decreasing.

The sign − prefixed to the hourly change of declination indicates that { south / north } declinations are { increasing. / decreasing.

Date		AT GREENWICH APPARENT NOON					POLARIS FOR THE MERIDIAN OF GREENWICH, CIVIL DATE AND MEAN TIME		
		THE SUN'S			Time Semi-diameter Passing Mer.	Equation of Time, Add to	Upper Culmination	Elongation Lat. 40°	Declination
		Apparent Declination	Diff. for 1 Hour	Semi-diameter		Subtract from Apparent Time			
APRIL, 1964									
		° ′ ″	″	′ ″	s	m s	h m	h m	° ′ +89 05 ″
Wed.	1	N 4 39 43.0	+57.78	16 01.64	64	3 51.19	1 17.6 P.M.	W.E. 7 13.6 P.M.	53.67
Thur.	2	5 02 47.3	57.57	16 01.36	65	3 33.30	1 13.7	7 09.6	53.37
Fri.	3	5 25 46.5	57.35	16 01.08	65	3 15.55	1 09.8	7 05.7	53.08
Sat.	4	5 48 39.9	57.10	16 00.79	65	2 57.98	1 05.8	7 01.8	52.80
Sun.	5	6 11 27.4	56.85	16 00.51	65	2 40.58	1 01.9	6 57.8	52.53
Mon.	6	6 34 08.6	56.58	16 00.23	65	2 23.40	12 57.9	6 53.9	52.25
Tues.	7	6 56 43.2	56.30	15 59.95	65	2 06.44	12 54.0	6 49.9	51.98
Wed.	8	7 19 10.8	56.00	15 59.67	65	1 49.71	12 50.1	6 46.0	51.69
Thur.	9	7 41 31.1	55.68	15 59.39	65	1 33.24	12 46.1	6 42.1	51.38
Fri.	10	8 03 43.7	55.36	15 59.11	65	1 17.05	12 42.2	6 38.1	51.06
Sat.	11	8 25 48.2	55.01	15 58.84	65	1 01.14	12 38.3	6 34.2	50.73
Sun.	12	8 47 44.4	54.66	15 58.57	65	0 45.53	12 34.3	6 30.3	50.38
Mon.	13	9 09 31.7	54.28	15 58.30	65	0 30.23	12 30.4	6 26.3	50.04
Tues.	14	9 31 10.0	53.90	15 58.03	65	0 15.24	12 26.5	6 22.4	49.71
Wed.	15	9 52 38.8	53.49	15 57.77	65	0 00.60	12 22.5	6 18.5	49.40
Thur.	16	10 13 57.8	53.08	15 57.51	65	0 13.71	12 18.6	6 14.5	49.11
Fri.	17	10 35 06.5	52.64	15 57.25	65	0 27.66	12 14.7	6 10.6	48.84
Sat.	18	10 56 04.7	52.20	15 56.99	65	0 41.24	12 10.7	6 06.7	48.58
Sun.	19	11 16 52.0	51.73	15 56.74	65	0 54.45	12 06.8	6 02.8	48.32
Mon.	20	11 37 28.0	51.26	15 56.48	65	1 07.25	12 02.9 P.M.	W.E. 5 58.8 P.M.	48.05
Tues.	21	11 57 52.3	50.77	15 56.23	65	1 19.65	11 58.9 A.M.	E.E. 6 03.0 A.M.	47.76
Wed.	22	12 18 04.9	50.27	15 55.98	65	1 31.62	11 55.0	5 59.1	47.46
Thur.	23	12 38 05.1	49.75	15 55.72	65	1 43.15	11 51.1	5 55.1	47.14
Fri.	24	12 57 52.8	49.22	15 55.47	66	1 54.23	11 47.2	5 51.2	46.81
Sat.	25	13 17 27.7	48.68	15 55.22	66	2 04.85	11 43.2	5 47.3	46.47
Sun.	26	13 36 49.5	48.13	15 54.97	66	2 14.97	11 39.3	5 43.4	46.14
Mon.	27	13 55 57.8	47.56	15 54.72	66	2 24.61	11 35.4	5 39.4	45.82
Tues.	28	14 14 52.4	46.98	15 54.48	66	2 33.73	11 31.4	5 35.5	45.50
Wed.	29	14 33 32.9	46.39	15 54.23	66	2 42.33	11 27.5	5 31.6	45.20
Thur.	30	N14 51 59.1	+45.79	15 53.98	66	2 50.40	11 23.6 A.M.	E.E. 5 27.7 A.M.	44.92
MAY, 1964									
Fri.	1	N15 10 10.6	+45.17	15 53.74	66	2 57.93	11 19.7 A.M.	E.E. 5 23.7 A.M.	44.65
Sat.	2	15 28 07.2	44.54	15 53.49	66	3 04.91	11 15.8	5 19.8	44.39
Sun.	3	15 45 48.6	43.90	15 53.25	66	3 11.33	11 11.8	5 15.9	44.13
Mon.	4	16 03 14.3	43.24	15 53.01	66	3 17.17	11 07.9	5 12.0	43.88
Tues.	5	16 20 24.3	42.58	15 52.78	66	3 22.45	11 04.0	5 08.0	43.62
Wed.	6	16 37 18.0	41.90	15 52.55	67	3 27.14	11 00.0	5 04.1	43.35
Thur.	7	16 53 55.3	41.20	15 52.32	67	3 31.26	10 56.1	5 00.2	43.06
Fri.	8	17 10 15.7	40.49	15 52.09	67	3 34.78	10 52.2	4 56.3	42.77
Sat.	9	17 26 19.0	39.78	15 51.86	67	3 37.73	10 48.3	4 52.3	42.46
Sun.	10	17 42 05.0	39.04	15 51.64	67	3 40.09	10 44.3	4 48.4	42.16
Mon.	11	17 57 33.2	38.30	15 51.43	67	3 41.86	10 40.4	4 44.5	41.86
Tues.	12	18 12 43.3	37.54	15 51.22	67	3 43.07	10 36.5	4 40.6	41.58
Wed.	13	18 27 35.1	36.77	15 51.01	67	3 43.69	10 32.6	4 36.7	41.34
Thur.	14	18 42 08.2	35.99	15 50.81	67	3 43.76	10 28.7	4 32.7	41.11
Fri.	15	18 56 22.4	35.19	15 50.61	67	3 43.28	10 24.8	4 28.8	40.91
Sat.	16	N19 10 17.2	+34.38	15 50.42	67	3 42.24	10 20.8 A.M.	E.E. 4 24.9 A.M.	40.71

The sign + prefixed to the hourly change of declination indicates that { north / south } declinations are { increasing. / decreasing.

The sign – prefixed to the hourly change of declination indicates that { south / north } declinations are { increasing. / decreasing.

For time of Western Elongation of Polaris for any date after April 20th, add 5^h 55.9^m to the time of Upper Culmination of the same date.

Date		AT GREENWICH APPARENT NOON					POLARIS FOR THE MERIDIAN OF GREENWICH, CIVIL DATE AND MEAN TIME		
		THE SUN'S			Time Semi-diameter Passing Mer.	Equation of Time, Subtract from / Add to Apparent Time	Upper Culmination	Elongation Lat. 40°	Declination
		Apparent Declination	Diff. for 1 Hour	Semi-diameter					
MAY, 1964									
		° ′ ″	″	′ ″	s	m s	h m	h m	° ′ +89 05 ″
Sat.	16	N19 10 17.2	+34.38	15 50.42	67	3 42.24	10 20.8 A.M.	E.E. 4 24.9 A.M.	40.71
Sun.	17	19 23 52.6	33.56	15 50.23	67	3 40.65	10 16.9	4 21.0	40.50
Mon.	18	19 37 08.1	32.73	15 50.04	68	3 38.54	10 13.0	4 17.1	40.28
Tues.	19	19 50 03.5	31.88	15 49.86	67	3 35.88	10 09.1	4 13.1	40.05
Wed.	20	20 02 38.5	31.03	15 49.68	68	3 32.71	10 05.2	4 09.2	39.81
Thur.	21	20 14 52.9	30.17	15 49.50	68	3 29.01	10 01.2	4 05.3	39.55
Fri.	22	20 26 46.4	29.29	15 49.33	68	3 24.79	9 57.3	4 01.4	39.29
Sat.	23	20 38 18.9	28.41	15 49.16	68	3 20.07	9 53.4	3 57.5	39.03
Sun.	24	20 49 30.0	27.52	15 48.99	68	3 14.83	9 49.5	3 53.5	38.78
Mon.	25	21 00 19.7	26.62	15 48.82	68	3 09.11	9 45.6	3 49.6	38.54
Tues.	26	21 10 47.6	25.71	15 48.66	68	3 02.89	9 41.6	3 45.7	38.31
Wed.	27	21 20 53.7	24.79	15 48.49	68	2 56.19	9 37.7	3 41.8	38.11
Thur.	28	21 30 37.6	23.87	15 48.33	68	2 49.03	9 33.8	3 37.9	37.92
Fri.	29	21 39 59.2	22.93	15 48.18	68	2 41.40	9 29.9	3 34.0	37.74
Sat.	30	21 48 58.3	21.99	15 48.03	68	2 33.32	9 26.0	3 30.0	37.58
Sun.	31	N21 57 34.7	+21.04	15 47.88	68	2 24.80	9 22.1 A.M.	E.E. 3 26.1 A.M.	37.41
JUNE, 1964									
Mon.	1	N22 05 48.3	+20.09	15 47.73	68	2 15.87	9 18.2 A.M.	E.E. 3 22.2 A.M.	37.25
Tues.	2	22 13 38.9	19.12	15 47.58	68	2 06.51	9 14.2	3 18.3	37.08
Wed.	3	22 21 06.2	18.15	15 47.44	68	1 56.77	9 10.3	3 14.4	36.90
Thur.	4	22 28 10.1	17.17	15 47.31	69	1 46.64	9 06.4	3 10.5	36.71
Fri.	5	22 34 50.5	16.19	15 47.18	69	1 36.15	9 02.5	3 06.5	36.51
Sat.	6	22 41 07.2	15.20	15 47.05	69	1 25.32	8 58.6	3 02.6	36.31
Sun.	7	22 47 00.0	14.20	15 46.92	69	1 14.17	8 54.7	2 58.7	36.11
Mon.	8	22 52 28.9	13.20	15 46.81	69	1 02.72	8 50.8	2 54.8	35.93
Tues.	9	22 57 33.7	12.19	15 46.70	69	0 51.00	8 46.8	2 50.9	35.78
Wed.	10	23 02 14.2	11.18	15 46.59	69	0 39.03	8 42.9	2 47.0	35.66
Thur.	11	23 06 30.6	10.17	15 46.49	69	0 26.84	8 39.0	2 43.1	35.56
Fri.	12	23 10 22.3	9.15	15 46.39	69	0 14.46	8 35.1	2 39.2	35.48
Sat.	13	23 13 49.7	8.12	15 46.30	69	0 01.92	8 31.2	2 35.3	35.40
Sun.	14	23 16 52.3	7.10	15 46.22	69	0 10.76	8 27.3	2 31.3	35.31
Mon.	15	23 19 30.3	6.07	15 46.14	69	0 23.55	8 23.4	2 27.4	35.20
Tues.	16	23 21 43.5	5.04	15 46.06	69	0 36.43	8 19.5	2 23.5	35.08
Wed.	17	23 23 32.0	4.00	15 45.99	69	0 49.37	8 15.5	2 19.6	34.95
Thur.	18	23 24 55.6	2.97	15 45.93	69	1 02.35	8 11.6	2 15.7	34.82
Fri.	19	23 25 54.3	1.93	15 45.86	69	1 15.35	8 07.7	2 11.8	34.68
Sat.	20	23 26 28.2	+ 0.90	15 45.81	69	1 28.34	8 03.8	2 07.9	34.55
Sun.	21	23 26 37.3	− 0.14	15 45.75	69	1 41.32	7 59.9	2 04.0	34.44
Mon.	22	23 26 21.6	1.17	15 45.70	69	1 54.25	7 56.0	2 00.0	34.34
Tues.	23	23 25 41.1	2.20	15 45.65	69	2 07.12	7 52.1	1 56.1	34.26
Wed.	24	23 24 35.9	3.23	15 45.60	69	2 19.89	7 48.2	1 52.2	34.19
Thur.	25	23 23 05.9	4.26	15 45.56	69	2 32.57	7 44.3	1 48.3	34.15
Fri.	26	23 21 11.3	5.29	15 45.53	69	2 45.11	7 40.4	1 44.4	34.11
Sat.	27	23 18 52.1	6.31	15 45.49	69	2 57.51	7 36.4	1 40.5	34.08
Sun.	28	23 16 08.4	7.33	15 45.46	69	3 09.75	7 32.5	1 36.6	34.05
Mon.	29	23 13 00.2	8.35	15 45.43	69	3 21.80	7 28.6	1 32.7	34.02
Tues.	30	23 09 27.6	9.36	15 45.41	69	3 33.64	7 24.7	1 28.8	33.98
Wed.	31	N23 05 30.7	−10.37	15 45.38	69	3 45.26	7 20.8 A.M.	E.E. 1 24.9 A.M.	33.93

The sign + prefixed to the hourly change of declination indicates that { north / south } declinations are { increasing. / decreasing.

The sign − prefixed to the hourly change of declination indicates that { south / north } declinations are { increasing. / decreasing.

Date	AT GREENWICH APPARENT NOON					POLARIS FOR THE MERIDIAN OF GREENWICH , CIVIL DATE AND MEAN TIME		
	THE SUN'S			Time Semi-diameter Passing Mer.	Equation of Time , Add to Apparent Time	Upper Culmination	Elongation Lat . 40°	Declination
	Apparent Declination	Diff . for 1 Hour	Semi - diameter					
	JULY , 1964							
	° ′ ″	″	′ ″	s	m s	h m	h m	° ′ +89 05 ″
Wed. 1	N23 05 30.7	−10.37	15 45.38	69	3 45.26	7 20.8 A.M.	E.E. 1 24.9 A.M.	33.93
Thur. 2	23 01 09.7	11.38	15 45.37	69	3 56.64	7 16.9	1 20.9	33.88
Fri. 3	22 56 24.4	12.39	15 45.36	69	4 07.77	7 13.0	1 17.0	33.81
Sat. 4	22 51 15.1	13.38	15 45.35	69	4 18.60	7 09.1	1 13.1	33.75
Sun. 5	22 45 42.1	14.37	15 45.35	69	4 29.14	7 05.2	1 09.2	33.71
Mon. 6	22 39 45.2	15.36	15 45.35	68	4 39.34	7 01.2	1 05.3	33.68
Tues. 7	22 33 24.7	16.34	15 45.36	68	4 49.21	6 57.3	1 01.4	33.68
Wed. 8	22 26 40.8	17.31	15 45.37	68	4 58.70	6 53.4	0 57.5	33.72
Thur. 9	22 19 33.6	18.28	15 45.39	68	5 07.80	6 49.5	0 53.6	33.77
Fri. 10	22 12 03.4	19.24	15 45.42	68	5 16.48	6 45.6	0 49.7	33.84
Sat. 11	22 04 10.1	20.19	15 45.45	68	5 24.73	6 41.7	0 45.8	33.90
Sun. 12	21 55 54.2	21.13	15 45.49	68	5 32.51	6 37.8	0 41.9	33.95
Mon. 13	21 47 15.7	22.07	15 45.53	68	5 39.81	6 33.9	0 37.9	33.98
Tues. 14	21 38 14.8	23.00	15 45.58	68	5 46.61	6 30.0	0 34.0	34.00
Wed. 15	21 28 51.8	23.92	15 45.63	68	5 52.90	6 26.1	0 30.1	34.01
Thur. 16	21 19 06.8	24.83	15 45.69	68	5 58.67	6 22.2	0 26.2	34.02
Fri. 17	21 09 00.2	25.72	15 45.75	68	6 03.90	6 18.3	0 22.3	34.03
Sat. 18	20 58 32.1	26.61	15 45.82	68	6 08.58	6 14.3	0 18.4	34.06
Sun. 19	20 47 42.7	27.49	15 45.89	68	6 12.70	6 10.4	0 14.5	34.10
Mon. 20	20 36 32.3	28.36	15 45.96	68	6 16.26	6 06.5	0 10.6	34.16
Tues. 21	20 25 01.2	29.22	15 46.04	67	6 19.25	6 02.6	0 06.7	34.23
Wed. 22	20 13 09.7	30.07	15 46.12	67	6 21.66	5 58.7	0 02.8 A.M. 11 58.9 P.M.	34.33
Thur. 23	20 00 57.9	30.91	15 46.20	67	6 23.48	5 54.8	11 55.0	34.43
Fri. 24	19 48 26.0	31.74	15 46.29	67	6 24.73	5 50.9	11 51.0	34.55
Sat. 25	19 35 34.5	32.55	15 46.38	67	6 25.38	5 47.0	11 47.1	34.67
Sun. 26	19 22 23.5	33.36	15 46.47	67	6 25.44	5 43.1	11 43.2	34.78
Mon. 27	19 08 53.3	34.15	15 46.57	67	6 24.92	5 39.2	11 39.3	34.89
Tues. 28	18 55 04.1	34.94	15 46.67	67	6 23.81	5 35.3	11 35.4	34.99
Wed. 29	18 40 56.3	35.71	15 46.77	67	6 22.10	5 31.3	11 31.5	35.08
Thur. 30	18 26 29.9	36.48	15 46.88	67	6 19.81	5 27.4	11 27.6	35.16
Fri. 31	N18 11 45.4	−37.23	15 46.99	67	6 16.93	5 23.5 A.M.	E.E. 11 23.7 P.M.	35.24
	AUGUST , 1964							
Sat. 1	N17 56 43.0	−37.97	15 47.10	67	6 13.46	5 19.6 A.M.	E.E. 11 19.8 P.M.	35.33
Sun. 2	17 41 23.0	38.70	15 47.21	67	6 09.41	5 15.7	11 15.9	35.44
Mon. 3	17 25 45.6	39.41	15 47.34	66	6 04.78	5 11.8	11 12.0	35.58
Tues. 4	17 09 51.2	40.12	15 47.47	66	5 59.56	5 07.9	11 08.1	35.74
Wed. 5	16 53 40.0	40.81	15 47.60	66	5 53.75	5 04.0	11 04.1	35.92
Thur. 6	16 37 12.4	41.48	15 47.73	66	5 47.36	5 00.1	11 00.2	36.13
Fri. 7	16 20 28.8	42.15	15 47.88	66	5 40.38	4 56.2	10 56.3	36.33
Sat. 8	16 03 29.3	42.80	15 48.03	66	5 32.82	4 52.3	10 52.4	36.53
Sun. 9	15 46 14.4	43.44	15 48.18	66	5 24.66	4 48.3	10 48.5	36.71
Mon. 10	15 28 44.3	44.07	15 48.33	66	5 15.93	4 44.4	10 44.6	36.88
Tues. 11	15 10 59.2	44.68	15 48.49	66	5 06.61	4 40.5	10 40.7	37.03
Wed. 12	14 52 59.8	45.27	15 48.66	66	4 56.70	4 36.6	10 36.8	37.18
Thur. 13	14 34 46.1	45.86	15 48.83	66	4 46.23	4 32.7	10 32.9	37.33
Fri. 14	14 16 18.5	46.43	15 49.01	66	4 35.19	4 28.8	10 28.9	37.49
Sat. 15	13 57 37.4	46.99	15 49.18	65	4 23.60	4 24.9	10 25.0	37.66
Sun. 16	N13 38 43.0	−47.53	15 49.37	65	4 11.46	4 21.0 A.M.	E.E. 10 21.1 P.M.	37.85

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The sign − prefixed to the hourly change of declination indicates that {south / north} declinations are {increasing . / decreasing .}

AT GREENWICH APPARENT NOON						POLARIS FOR THE MERIDIAN OF GREENWICH, CIVIL DATE AND MEAN TIME		
Date	THE SUN'S			Time Semi-diameter Passing Mer.	Equation of Time, Add to / Subtract from Apparent Time	Upper Culmination	Elongation Lat. 40°	Declination
	Apparent Declination	Diff. for 1 Hour	Semi-diameter					
AUGUST, 1964								
	° ′ ″	″	′ ″	s	m s	h m	h m	° ′ +89 05 ″
Sun. 16	N13 38 43.0	−47.53	15 49.37	65	4 11.46	4 21.0 A.M.	E.E. 10 21.1 P.M.	37.85
Mon. 17	13 19 35.8	48.07	15 49.56	65	3 58.79	4 17.1	10 17.2	38.05
Tues. 18	13 00 15.9	48.58	15 49.75	65	3 45.59	4 13.2	10 13.3	38.27
Wed. 19	12 40 43.8	49.09	15 49.94	65	3 31.88	4 09.3	10 09.4	38.51
Thur. 20	12 20 59.7	49.58	15 50.13	65	3 17.69	4 05.3	10 05.5	38.76
Fri. 21	12 01 04.0	50.06	15 50.32	65	3 03.01	4 01.4	10 01.6	39.01
Sat. 22	11 40 56.9	50.52	15 50.52	65	2 47.87	3 57.5	9 57.7	39.26
Sun. 23	11 20 38.8	50.98	15 50.72	65	2 32.28	3 53.6	9 53.7	39.50
Mon. 24	11 00 09.9	51.42	15 50.92	65	2 16.26	3 49.7	9 49.8	39.73
Tues. 25	10 39 30.7	51.85	15 51.13	65	1 59.83	3 45.8	9 45.9	39.95
Wed. 26	10 18 41.3	52.26	15 51.33	65	1 43.00	3 41.9	9 42.0	40.16
Thur. 27	9 57 42.0	52.67	15 51.54	65	1 25.81	3 37.9	9 38.1	40.37
Fri. 28	9 36 33.1	53.06	15 51.75	65	1 08.24	3 34.0	9 34.2	40.58
Sat. 29	9 15 15.0	53.44	15 51.96	64	0 50.34	3 30.1	9 30.3	40.81
Sun. 30	8 53 48.0	53.81	15 52.18	64	0 32.13	3 26.2	9 26.4	41.06
Mon. 31	N 8 32 12.2	−54.16	15 52.39	64	0 13.60	3 22.3 A.M.	E.E. 9 22.5 P.M.	41.33
SEPTEMBER, 1964								
Tues. 1	N 8 10 28.2	−54.50	15 52.61	64	0 05.22	3 18.4 A.M.	E.E. 9 18.5 P.M.	41.63
Wed. 2	7 48 36.2	54.83	15 52.84	64	0 24.31	3 14.5	9 14.6	41.94
Thur. 3	7 26 36.5	55.14	15 53.06	64	0 43.66	3 10.6	9 10.7	42.26
Fri. 4	7 04 29.5	55.44	15 53.29	64	1 03.26	3 06.7	9 06.8	42.58
Sat. 5	6 42 15.6	55.72	15 53.52	64	1 23.09	3 02.7	9 02.9	42.89
Sun. 6	6 19 55.0	55.99	15 53.76	64	1 43.15	2 58.8	8 59.0	43.18
Mon. 7	5 57 28.2	56.24	15 54.00	64	2 03.41	2 54.9	8 55.0	43.45
Tues. 8	5 34 55.3	56.48	15 54.25	64	2 23.85	2 51.0	8 51.1	43.71
Wed. 9	5 12 16.9	56.71	15 54.50	64	2 44.49	2 47.1	8 47.2	43.97
Thur. 10	4 49 33.3	56.92	15 54.75	64	3 05.27	2 43.2	8 43.3	44.24
Fri. 11	4 26 44.7	57.12	15 55.00	64	3 26.20	2 39.2	8 39.4	44.51
Sat. 12	4 03 51.6	57.30	15 55.26	64	3 47.26	2 35.3	8 35.5	44.80
Sun. 13	3 40 54.2	57.47	15 55.52	64	4 08.41	2 31.4	8 31.6	45.11
Mon. 14	3 17 53.1	57.62	15 55.78	64	4 29.66	2 27.5	8 27.6	45.43
Tues. 15	2 54 48.3	57.77	15 56.04	64	4 50.97	2 23.6	8 23.7	45.77
Wed. 16	2 31 40.3	57.89	15 56.31	64	5 12.34	2 19.7	8 19.8	46.11
Thur. 17	2 08 29.5	58.00	15 56.57	64	5 33.72	2 15.8	8 15.9	46.46
Fri. 18	1 45 16.1	58.10	15 56.84	64	5 55.11	2 11.8	8 12.0	46.81
Sat. 19	1 22 00.5	58.19	15 57.11	64	6 16.48	2 07.9	8 08.1	47.16
Sun. 20	0 58 43.1	58.26	15 57.37	64	6 37.81	2 04.0	8 04.1	47.49
Mon. 21	0 35 24.0	58.32	15 57.64	64	6 59.07	2 00.1	8 00.2	47.81
Tues. 22	N 0 12 03.7	58.37	15 57.91	64	7 20.25	1 56.1	7 56.3	48.12
Wed. 23	S 0 11 17.5	58.40	15 58.17	64	7 41.31	1 52.2	7 52.4	48.42
Thur. 24	0 34 39.5	58.42	15 58.44	64	8 02.22	1 48.3	7 48.4	48.72
Fri. 25	0 58 01.8	58.43	15 58.71	64	8 22.98	1 44.4	7 44.5	49.03
Sat. 26	1 21 24.0	58.42	15 58.97	64	8 43.55	1 40.5	7 40.6	49.35
Sun. 27	1 44 46.1	58.41	15 59.24	64	9 03.91	1 36.6	7 36.7	49.71
Mon. 28	2 08 07.5	58.37	15 59.51	64	9 24.04	1 32.6	7 32.8	50.08
Tues. 29	2 31 27.9	58.32	15 59.77	64	9 43.92	1 28.7	7 28.9	50.47
Wed. 30	2 54 47.0	58.26	16 00.04	64	10 03.52	1 24.8	7 24.9	50.87
Thur. 31	S 3 18 04.4	−58.18	16 00.31	64	10 22.84	1 20.9 A.M.	E.E. 7 21.0 P.M.	51.27

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AT GREENWICH APPARENT NOON							POLARIS FOR THE MERIDIAN OF GREENWICH , CIVIL DATE AND MEAN TIME		
Date		THE SUN'S			Time Semi-diameter Passing Mer.	Equation of Time , Subtract from Apparent Time	Upper Culmination	Elongation Lat . 40°	Declination
		Apparent Declination	Diff . for 1 Hour	Semi-diameter					
OCTOBER, 1964									
		° ′ ″	″	′ ″	s	m s	h m	h m	° ′ +89 05 ″
Thur.	1	S 3 18 04.4	−58.18	16 00.31	64	10 22.84	1 20.9 A.M.	E.E. 7 21.0 P.M.	51.27
Fri.	2	3 41 19.8	58.09	16 00.58	64	10 41.85	1 17.0	7 17.1	51.66
Sat.	3	4 04 32.8	57.98	16 00.86	64	11 00.52	1 13.0	7 13.2	52.03
Sun.	4	4 27 42.8	57.86	16 01.13	64	11 18.86	1 09.1	7 09.2	52.38
Mon.	5	4 50 49.8	57.72	16 01.41	65	11 36.84	1 05.2	7 05.3	52.72
Tues.	6	5 13 53.2	57.56	16 01.69	65	11 54.44	1 01.3	7 01.4	53.05
Wed.	7	5 36 52.7	57.39	16 01.97	65	12 11.65	0 57.3	6 57.5	53.38
Thur.	8	5 59 47.8	57.20	16 02.25	65	12 28.45	0 53.4	6 53.6	53.72
Fri.	9	6 22 38.2	56.99	16 02.53	65	12 44.83	0 49.5	6 49.6	54.07
Sat.	10	6 45 23.5	56.77	16 02.81	65	13 00.77	0 45.6	6 45.7	54.43
Sun.	11	7 08 03.3	56.54	16 03.09	65	13 16.25	0 41.7	6 41.8	54.81
Mon.	12	7 30 37.3	56.28	16 03.37	65	13 31.25	0 37.7	6 37.9	55.20
Tues.	13	7 53 04.9	56.01	16 03.65	65	13 45.76	0 33.8	6 33.9	55.60
Wed.	14	8 15 26.0	55.73	16 03.93	65	13 59.76	0 29.9	6 30.0	56.00
Thur.	15	8 37 40.0	55.43	16 04.21	65	14 13.22	0 26.0	6 26.1	56.41
Fri.	16	8 59 46.5	55.11	16 04.49	65	14 26.14	0 22.0	6 22.2	56.81
Sat.	17	9 21 45.3	54.78	16 04.77	65	14 38.49	0 18.1	6 18.2	57.20
Sun.	18	9 43 35.8	54.43	16 05.05	65	14 50.25	0 14.2	6 14.3	57.57
Mon.	19	10 05 17.8	54.06	16 05.32	66	15 01.41	0 10.2	6 10.4	57.93
Tues.	20	10 26 50.9	53.68	16 05.59	66	15 11.95	0 06.3	6 06.4	58.28
Wed.	21	10 48 14.7	53.29	16 05.86	66	15 21.83	0 02.4 A.M. 11 58.5 P.M.	E.E. 6 02.5 P.M.	58.62 58.96
Thur.	22	11 09 28.9	52.88	16 06.13	66	15 31.06	11 54.5	W.E. 5 54.4 A.M.	59.32
Fri.	23	11 30 33.0	52.46	16 06.39	66	15 39.60	11 50.6	5 50.5	59.70
Sat.	24	11 51 26.8	52.02	16 06.66	66	15 47.43	11 46.7	5 46.6	60.10
Sun.	25	12 12 10.0	51.57	16 06.92	66	15 54.54	11 42.8	5 42.6	60.53
Mon.	26	12 32 42.0	51.09	16 07.17	66	16 00.91	11 38.8	5 38.7	60.95
Tues.	27	12 53 02.4	50.61	16 07.42	66	16 06.53	11 34.9	5 34.8	61.38
Wed.	28	13 13 11.0	50.10	16 07.68	66	16 11.39	11 31.0	5 30.8	61.80
Thur.	29	13 33 07.3	49.58	16 07.93	67	16 15.46	11 27.0	5 26.9	62.20
Fri.	30	13 52 50.8	49.04	16 08.18	67	16 18.74	11 23.1	5 23.0	62.58
Sat.	31	S14 12 21.3	−48.48	16 08.43	67	16 21.22	11 19.2 P.M.	W.E. 5 19.0 A.M.	62.94
NOVEMBER, 1964									
Sun.	1	S14 31 38.1	−47.91	16 08.67	67	16 22.91	11 15.2 P.M.	W.E. 5 15.1 A.M.	63.29
Mon.	2	14 50 41.0	47.32	16 08.92	67	16 23.78	11 11.3	5 11.2	63.64
Tues.	3	15 09 29.4	46.71	16 09.17	67	16 23.83	11 07.4	5 07.2	63.98
Wed.	4	15 28 03.0	46.08	16 09.41	67	16 23.06	11 03.4	5 03.3	64.33
Thur.	5	15 46 21.3	45.44	16 09.66	67	16 21.47	10 59.5	4 59.4	64.70
Fri.	6	16 04 24.0	44.78	16 09.90	67	16 19.05	10 55.6	4 55.4	65.07
Sat.	7	16 22 10.6	44.10	16 10.14	68	16 15.80	10 51.6	4 51.5	65.46
Sun.	8	16 39 40.6	43.40	16 10.38	68	16 11.72	10 47.7	4 47.6	65.86
Mon.	9	16 56 53.7	42.68	16 10.62	68	16 06.81	10 43.8	4 43.6	66.26
Tues.	10	17 13 49.4	41.95	16 10.85	68	16 01.07	10 39.8	4 39.7	66.66
Wed.	11	17 30 27.4	41.20	16 11.08	68	15 54.49	10 35.9	4 35.8	67.05
Thur.	12	17 46 47.2	40.44	16 11.31	68	15 47.08	10 32.0	4 31.8	67.44
Fri.	13	18 02 48.3	39.65	16 11.54	68	15 38.83	10 28.0	4 27.9	67.81
Sat.	14	18 18 30.5	38.85	16 11.77	68	15 29.76	10 24.1	4 24.0	68.16
Sun.	15	18 33 53.3	38.04	16 11.99	69	15 19.86	10 20.1	4 20.0	68.50
Mon .	16	S18 48 56.2	−37.21	16 12.20	69	15 09.13	10 16.2 P.M.	W.E. 4 16.1 A.M.	68.82

The sign + prefixed to the hourly change of declination indicates that { north / south } declinations are { increasing . / decreasing .

The sign − prefixed to the hourly change of declination indicates that { south / north } declinations are { increasing . / decreasing .

For time of Eastern Elongation of Polaris for any date after October 21st , subtract 5^h 55.9^m from the time of Upper Culmination of the same date .

AT GREENWICH APPARENT NOON							POLARIS FOR THE MERIDIAN OF GREENWICH, CIVIL DATE AND MEAN TIME		
Date		THE SUN'S			Time Semi-diameter Passing Mer.	Equation of Time, Subtract from / Add to Apparent Time	Upper Culmination	Elongation Lat. 40°	Declination
		Apparent Declination	Diff. for 1 Hour	Semi-diameter					
NOVEMBER, 1964									
		° ′ ″	″	′ ″	s	m s	h m	h m	° ′ +89 06 ″
Mon.	16	S18 48 56,2	−37,21	16 12.20	69	15 09,13	10 16.2 P.M.	W.E. 4 16,1 A.M.	08,82
Tues.	17	19 03 39,2	36,36	16 12,41	69	14 57.58	10 12,3	4 12.1	09,14
Wed.	18	19 18 01,6	35,50	16 12,62	69	14 45,21	10 08,3	4 08,2	09,47
Thur.	19	19 32 03,1	34.62	16 12.83	69	14 32.01	10 04.4	4 04.3	09.81
Fri.	20	19 45 43.5	33.74	16 13.03	69	14 18,00	10 00.5	4 00,3	10.17
Sat.	21	19 59 02,4	32.83	16 13.22	69	14 03,17	9 56,5	3 56,4	10.56
Sun.	22	20 11 59.4	31,91	16 13,41	69	13 47.53	9 52.6	3 52,5	10,96
Mon.	23	20 24 34,3	30,98	16 13.59	69	13 31,09	9 48,6	3 48,5	11,35
Tues.	24	20 36 46.6	30,04	16 13.77	70	13 13.85	9 44,7	3 44,6	11,74
Wed.	25	20 48 36,0	29.08	16 13,94	70	12 55,83	9 40,8	3 40.6	12,11
Thur.	26	21 00 02,2	28,10	16 14.11	70	12 37,04	9 36,8	3 36,7	12,45
Fri.	27	21 11 05,0	27.11	16 14,28	70	12 17,50	9 32,9	3 32,8	12,77
Sat.	28	21 21 43,7	26,11	16 14.44	70	11 57,22	9 28,9	3 28,8	13,07
Sun.	29	21 31 58,3	25,10	16 14.60	70	11 36,22	9 25,0	3 24,9	13,36
Mon.	30	S21 41 48,3	−24,07	16 14.76	70	11 14,52	9 21,0 P.M.	W.E. 3 20,9 A.M.	13.65
DECEMBER, 1964									
Tues.	1	S21 51 13,5	−23.03	16 14.91	70	10 52,15	9 17.1 P.M.	W.E. 3 17.0 A.M.	13,94
Wed.	2	22 00 13.6	21,97	16 15.06	70	10 29,14	9 13.2	3 13,0	14,24
Thur.	3	22 08 48,3	20,91	16 15.21	70	10 05,49	9 09.2	3 09.1	14.55
Fri.	4	22 16 57.3	19.83	16 15.35	70	9 41,26	9 05.3	3 05.2	14.87
Sat.	5	22 24 40,3	18,75	16 15,49	71	9 16,45	9 01,3	3 01,2	15,19
Sun.	6	22 31 57.2	17,65	16 15.63	71	8 51,10	8 57.4	2 57.3	15,52
Mon.	7	22 38 47.6	16,54	16 15,76	71	8 25,25	8 53,4	2 53,3	15,85
Tues.	8	22 45 11,3	15,43	16 15.89	71	7 58,91	8 49.5	2 49,4	16.17
Wed.	9	22 51 08,2	14,30	16 16,02	71	7 32,13	8 45,5	2 45,4	16,48
Thur.	10	22 56 37.9	13.17	16 16.15	71	7 04.92	8 41,6	2 41,5	16,78
Fri.	11	23 01 40,4	12,03	16 16,26	71	6 37,34	8 37.6	2 37,5	17,05
Sat.	12	23 06 15.5	10,89	16 16.37	71	6 09,39	8 33,7	2 33,6	17.31
Sun.	13	23 10 22,9	9.73	16 16,48	71	5 41,13	8 29,7	2 29.6	17,54
Mon.	14	23 14 02.6	8,57	16 16.59	71	5 12,57	8 25.8	2 25.7	17.77
Tues.	15	23 17 14,5	7,41	16 16,69	71	4 43,76	8 21,9	2 21,7	18,00
Wed.	16	23 19 58,3	6,24	16 16,78	71	4 14,71	8 17.9	2 17.8	18,24
Thur.	17	23 22 14.3	5.08	16 16,87	71	3 45,46	8 14,0	2 13.8	18,49
Fri.	18	23 24 02,0	3,90	16 16,95	71	3 16,05	8 10,0	2 09,9	18,76
Sat.	19	23 25 21,7	2,73	16 17,02	71	2 46,48	8 06,1	2 06,0	19,05
Sun.	20	23 26 13,2	1,56	16 17,09	71	2 16,81	8 02,1	2 02,0	19,35
Mon.	21	23 26 36,5	− 0,38	16 17,16	71	1 47,05	7 58,2	1 58,1	19,64
Tues.	22	23 26 31,6	+ 0,79	16 17,21	71	1 17,23	7 54,2	1 54,1	19,90
Wed.	23	23 25 58,4	1,97	16 17,26	71	0 47,39	7 50,3	1 50,2	20,14
Thur.	24	23 24 57,0	3,15	16 17,31	71	0 17,54	7 46,3	1 46,2	20,36
Fri.	25	23 23 27,3	4,32	16 17,35	71	0 12,26	7 42,4	1 42,2	20,55
Sat.	26	23 21 29,4	5,50	16 17,38	71	0 41,99	7 38,4	1 38,3	20,72
Sun.	27	23 19 03,3	6,67	16 17,41	71	1 11,62	7 34,5	1 34,3	20,89
Mon.	28	23 16 09,2	7,84	16 17,43	71	1 41,11	7 30,5	1 30,4	21,05
Tues.	29	23 12 47,0	9,01	16 17,45	71	2 10,41	7 26,6	1 26,4	21,22
Wed.	30	23 08 56,9	10,17	16 17,47	71	2 39,51	7 22,6	1 22,5	21,39
Thur.	31	23 04 39,0	11,32	16 17,48	71	3 08,36	7 18,7	1 18,5	21,58
Fri.	32	S22 59 53,3	+12,48	16 17.48	71	3 36,93	7 14,7 P.M.	W.E. 1 14,6 A.M.	21,76

The sign + prefixed to the hourly change of declination indicates that { north / south } declinations are { increasing. / decreasing.

The sign − prefixed to the hourly change of declination indicates that { south / north } declinations are { increasing. / decreasing.

SELECTED STARS

Serial Number this list	No. from Nautical Almanac	Constellation Name	North Declination			South Declination		
			R. A.	Decl.	Mag.	R. A.	Decl.	Mag.
			h m	°		h m	°	
1	1	α Andromedae (Alpheratz)	0 07	+29	2.1			
2 x X		β Hydri				0 24	−77	2.9
3	4	β Ceti (Diphda)				0 42	−18	2.2
4 E		α Ursae Minoris (Polaris)	1 59	+89	2.1			
5	6	α Arietis (Hamal)	2 05	+23	2.2			
6	10	α Tauri (Aldebaran)	4 34	+16	1.1			
7	11	β Orionis (Rigel)				5 13	− 8	0.3
8	12	α Aurigae (Capella)	5 14	+46	0.2			
9	16	α Orionis (Betelgeuse)	5 53	+ 7	0.5 v			
10 x	17	α Carinae (Canopus)				6 23	−53	−0.9
11	18	α Canis Majoris (Sirius)				6 44	−17	−1.6
12	20	α Canis Minoris (Procyon)	7 37	+ 5	0.5			
13	21	β Geminorum (Pollux)	7 43	+28	1.2			
14	25	α Hydrae (Alphard)				9 26	− 9	2.2
15	26	α Leonis (Regulus)	10 06	+12	1.3			
16	28	β Leonis (Denebola)	11 47	+15	2.2			
17	33	α Virginis (Spica)				13 23	−11	1.2
18 x	36	θ Centauri (Menkent)				14 05	−36	2.3
19	37	α Bootis (Arcturus)	14 14	+19	0.2			
20	41	α Coronae Borealis (Alphecca)	15 33	+27	2.3			
21 x	42	α Scorpii (Antares)				16 27	−26	1.2
22	46	α Ophiuchi (Rasalhague)	17 33	+13	2.1			
23	49	α Lyrae (Vega)	18 36	+39	0.1			
24 x	50	σ Sagittarii (Nunki)				18 53	−26	2.1
25	51	α Aquilae (Altair)	19 49	+ 9	0.9			
26	54	ε Pegasi (Enif)	21 42	+10	2.5			
27 x	56	α Piscis Australis (Fomalhaut)				22 56	−30	1.3
28	57	α Pegasi (Markab)	23 03	+15	2.6			

x: Required for stations south of 30° north latitude.
X: South circumpolar; not included in principal list of stars, Nautical Almanac.
E: Tabulated in this Ephemeris for daily position, including elongation.
v: Varies from 0.1 to 1.2 in magnitude or brilliancy.

α: Alpha. β: Beta. ε: Epsilon. θ: Theta. σ: Sigma. These designations are in the order of brightness, each within its own constellation.

The planets and the bright stars Capella, Canopus, and Vega, are tabulated as an aid in finding stellar positions.

For the south circumpolar star, No. 2 " β Hydri ", the horizontal angles, and the hour angle at elongation, may be found by the following equations (the lat. and decl. being treated as positive):

At elongation: $\cos t = \cot \delta \tan \varphi$; and, $\sin A = \dfrac{\cos \delta}{\cos \varphi}$

At any hour angle: $$\tan A = \frac{\sin t}{\cos \varphi \tan \delta - \sin \varphi \cos t}$$

The product " $\sin \varphi \cos t$ " is subtracted for hour angles 0° to 90°; added for hour angles 90° to 180°. The hour angle " t " in these equations is in sidereal rate; conversions page 27.

STAR TABLES , MERIDIAN OF GREENWICH , CIVIL DATE AND MEAN TIME

No.	Mag.	Transit	Decl.	Transit	Decl.	Transit	Decl.	Transit	Decl.	Transit	
		Jan. 1		Jan. 16		Feb. 1		Feb. 16		Subtract for day of month	
		h m	° ′	h m	′	h m	′	h m	′		m
1 - 1	2.1	5 24.9 PM	+28 53.5	4 25.9 PM	53.5	3 23.0 PM	53.5	2 24.0 PM	53.4	1	0.0
2	2.9	5 42.2	−77 27.9	4 43.2	27.8	3 40.3	27.8	2 41.3	27.7	2	3.9
3 - 4	2.2	6 00.1	−18 11.3	5 01.1	11.3	3 58.2	11.3	2 59.2	11.3	3	7.9
4	2.1	7 17.1	+89 06.0	6 17.8	06.1	5 14.5	06.1	4 15.2	06.1	4	11.8
5 - 6	2.2	7 23.2	+23 17.6	6 24.2	17.6	5 21.3	17.5	4 22.3	17.5	5	15.7
6 - 10	1.1	9 51.5	+16 26.3	8 52.5	26.2	7 49.6	26.2	6 50.6	26.2	6	19.7
7 - 11	0.3	10 30.4	− 8 14.6	9 31.4	14.7	8 28.5	14.7	7 29.5	14.7	7	23.6
8 - 12	0.2	10 31.6	+45 57.8	9 32.6	57.9	8 29.7	57.9	7 30.7	57.9	8	27.5
9 - 16	0.5 v	11 10.7	+ 7 24.1	10 11.7	24.0	9 08.8	24.0	8 09.8	24.0	9	31.5
10 - 17	−0.9	11 40.5 PM	−52 40.6	10 41.6	40.7	9 38.7	40.7	8 39.7	40.8	10	35.4
11 - 18	−1.6	0 04.8 AM	−16 39.9	11 01.9	40.0	9 59.0	40.1	9 00.0	40.1	11	39.3
Jan. 2		{0 00.9 AM 11 56.9 PM}								12	43.2
12 - 20	0.5	0 58.5 AM	+ 5 19.1	11 55.6 PM	19.1	10 52.7	19.0	9 53.7	19.0	13	47.2
Jan. 15		{0 03.5 AM 11 59.5 PM}								14	51.1
13 - 21	1.2	1 04.2 AM	+28 06.8	0 05.2 AM	06.8	10 58.4 PM	06.9	9 59.4	06.9	15	55.0
Jan. 17				{0 01.3 AM 11 57.4 PM}						16	0.0
14 - 25	2.2	2 46.6	− 8 29.9	1 47.6 AM	30.1	0 44.7 AM	30.1	11 41.8 PM	30.2	17	3.9
Feb. 12						{0 01.5 AM 11 57.6 PM}				18	7.9
15 - 26	1.3	3 27.1	+12 08.6	2 28.2	08.6	1 25.3 AM	08.6	0 26.3 AM	08.6	19	11.8
Feb. 22								{0 02.7 AM 11 58.8 PM}		20	15.7
16 - 28	2.2	5 07.6	+14 46.4	4 08.7	46.4	3 05.8	46.3	2 06.8 AM	46.3	21	19.7
17 - 33	1.2	6 43.4	−10 58.3	5 44.5	58.3	4 41.6	58.4	3 42.6	58.4	22	23.6
18 - 36	2.3	7 24.6	−36 11.3	6 25.6	11.4	5 22.7	11.4	4 23.8	11.5	23	27.5
19 - 37	0.2	7 34.0	+19 22.1	6 35.0	22.1	5 32.1	22.0	4 33.2	22.0	24	31.5
20 - 41	2.3	8 52.9	+26 50.1	7 54.0	50.0	6 51.1	49.9	5 52.1	49.9	25	35.4
21 - 42	1.2	9 46.8	−26 21.1	8 47.8	21.1	7 44.9	21.1	6 46.0	21.2	26	39.3
22 - 46	2.1	10 52.7	+12 35.1	9 53.7	35.0	8 50.8	35.0	7 51.8	34.9	27	43.2
23 - 49	0.1	11 55.0 AM	+38 45.0	10 56.0	44.9	9 53.1	44.8	8 54.1	44.7	28	47.2
24 - 50	2.1	12 12.2 PM[2]	−26 20.6	11 13.3 AM	20.6	10 10.4	20.6	9 11.4	20.6	29	51.1
25 - 51	0.9	1 08.1	+ 8 46.3	12 09.1 PM	46.3	11 06.2 AM	46.2	10 07.2 AM	46.2	30	55.0
26 - 54	2.5	3 01.2	+ 9 42.5	2 02.2	42.5	12 59.3 PM	42.4	12 00.3 PM	42.4	31	59.0
27 - 56	1.3	4 14.2	−29 49.1	3 15.2	49.1	2 12.3	49.0	1 13.4	49.0		
28 - 57	2.6	4 21.5 PM	+15 00.6	3 22.5 PM	00.6	2 19.6 PM	00.6	1 20.6 PM	00.5		
[1] Venus	−3.5	2 14 PM	−19°	2 28 PM	−13°	2 37 PM	− 6°	2 43 PM	+ 2°		
[2] Mars	1.3	12 50 PM	−23°	12 40 PM	−21°	12 29 PM	−17°	12 16 PM	−14°		
[3] Jupiter	−1.9	6 00 PM	+ 3°	5 07 PM	+ 4°	4 13 PM	+ 5°	3 24 PM	+ 6°		
[4] Saturn	1.0	2 52 PM	−16°	1 59 PM	−15°	1 04 PM	−15°	12 12 PM	−14°		

Footnotes indicate near proximity of a planet to a star in time of transit and declination .

For time of transit subsequent to a star's double transit and until the next tabulated date , subtract for the number of days counting from the second transit of that date . All other interpolations may be taken directly by reference to the day of the month .

STAR TABLES , MERIDIAN OF GREENWICH , CIVIL DATE AND MEAN TIME

No.	Mag.	Transit	Decl.	Transit	Decl.	Transit	Decl.	Transit	Decl.	Transit Subtract for day of month	
		Mar. 1		Mar. 16		Apr. 1		Apr. 16			
		h m	° ′	h m	′	h m	′	h m	′		m
1 - 1	2.1	1 29.0 PM	+28 53.4	12 30.0 PM	53.4	11 27.1 AM	53.3	10 28.1 AM	53.3	1	0.0
2	2.9	1 46.2	−77 27.6	12 47.2	27.5	11 44.3 AM	27.4	10 45.4	27.4	2	3.9
3 - 4	2.2	2 04.1	−18 11.3	1 05.2	11.2	12 02.3 PM	11.2	11 03.3 AM	11.1	3	7.9
4	2.1	3 19.9	+89 06.0	2 20.7	06.0	1 17.6	05.9	12 18.6 PM	05.8	4	11.8
5 - 6	2.2	3 27.3	+23 17.5	2 28.3[1]	17.5	1 25.4	17.5	12 26.4[3]	17.5	5	15.7
6 - 10	1.1	5 55.6	+16 26.2	4 56.6	26.2	3 53.7[1]	26.2	2 54.7[1]	26.2	6	19.7
7 - 11	0.3	6 34.4	− 8 14.7	5 35.5	14.7	4 32.6	14.7	3 33.6	14.7	7	23.6
8 - 12	0.2	6 35.7	+45 57.9	5 36.7	57.9	4 33.8	57.9	3 34.8	57.9	8	27.5
9 - 16	0.5 v	7 14.8	+ 7 24.0	6 15.8	24.0	5 12.9	24.0	4 13.9	24.0	9	31.5
10 - 17	−0.9	7 44.6	−52 40.8	6 45.6	40.9	5 42.7	40.9	4 43.7	40.8	10	35.4
11 - 18	−1.6	8 05.0	−16 40.1	7 06.0	40.1	6 03.1	40.1	5 04.1	40.1	11	39.3
12 - 20	0.5	8 58.7	+ 5 19.0	7 59.7	19.0	6 56.8	19.0	5 57.8	19.0	12	43.2
13 - 21	1.2	9 04.4	+28 06.9	8 05.4	06.9	7 02.5	06.9	6 03.5	06.9	13	47.2
14 - 25	2.2	10 46.8	− 8 30.2	9 47.8	30.2	8 44.9	30.2	7 45.9	30.3	14	51.1
15 - 26	1.3	11 27.3 PM	+12 08.6	10 28.3 PM	08.6	9 25.4	08.6	8 26.5	08.6	15	55.0
16 - 28	2.2	1 11.7 AM	+14 46.3	0 12.8 AM	46.3	11 05.9 PM	46.3	10 06.9	46.3	16	0.0
Mar. 19				0 01.0 AM 11 57.0 PM						17	3.9
17 - 33	1.2	2 47.5	−10 58.5	1 48.6 AM	58.5	0 45.7 AM	58.5	11 42.8 PM	58.5	18	7.9
Apr. 12						0 02.4 AM 11 58.5 PM				19	11.8
18 - 36	2.3	3 28.7	−36 11.5	2 29.7	11.6	1 26.8 AM	11.6	0 27.8 AM	11.7	20	15.7
Apr. 23								0 00.3 AM 11 56.4 PM		21	19.7
19 - 37	0.2	3 38.1	+19 22.0	2 39.2	22.0	1 36.3	22.0	0 37.3 AM	22.0	22	23.6
Apr. 25								0 01.9 AM 11 58.0 PM		23	27.5
20 - 41	2.3	4 57.0	+26 49.9	3 58.1	49.9	2 55.2	49.9	1 56.2 AM	49.9	24	31.5
21 - 42	1.2	5 50.9	−26 21.2	4 52.0	21.2	3 49.1	21.2	2 50.1	21.2	25	35.4
22 - 46	2.1	6 56.8	+12 34.9	5 57.8	34.9	4 54.9	34.9	3 56.0	34.9	26	39.3
23 - 49	0.1	7 59.1	+38 44.7	7 00.1	44.7	5 57.2	44.7	4 58.3	44.7	27	43.2
24 - 50	2.1	8 16.4	−26 20.6	7 17.4	20.6	6 14.5	20.6	5 15.5	20.6	28	47.2
25 - 51	0.9	9 12.2	+ 8 46.2	8 13.2	46.1	7 10.3	46.1	6 11.4	46.1	29	51.1
26 - 54	2.5	11 05.3 AM	+ 9 42.4	10 06.3	42.4	9 03.4	42.4	8 04.4	42.4	30	55.0
27 - 56	1.3	12 18.3 PM	−29 49.0	11 19.3	48.9	10 16.4	48.9	9 17.5	48.8	31	59.0
28 - 57	2.6	12 25.6 PM	+15 00.5	11 26.6 AM	00.5	10 23.7 AM	00.5	9 24.7 AM	00.5		
[1] Venus	−3.9	2 47 PM	+ 9°	2 52 PM	+16°	2 58 PM	+22°	3 02 PM	+26°		
[2] Mars	1.4	12 03 PM	−10°	11 48 AM	− 5°	11 31 AM	0°	11 14 AM	+ 5°		
[3] Jupiter	−1.6	2 39 PM	+ 7°	1 53 PM	+ 8°	1 04 PM	+10°	12 18 PM	+11°		
[4] Saturn	1.1	11 23 AM	−14°	10 31 AM	−13°	9 34 AM	−12°	8 41 AM	−12°		

Footnotes indicate near proximity of a planet to a star in time of transit and declination .

For reduction of time of transit from the Greenwich mean time to the local mean time at the longitude of the station , see table of Sidereal Conversions , page 27 .

STAR TABLES , MERIDIAN OF GREENWICH , CIVIL DATE AND MEAN TIME

No.	Mag.	Transit	Decl.	Transit	Decl.	Transit	Decl.	Transit	Decl.	Transit Subtract for day of month	
		May 1		May 16		June 1		June 16			
		h m	° ′	h m	′	h m	′	h m	′		m
1 - 1	2,1	9 29.1 AM	+28 53,3	8 30,2 AM	53,3	7 27,3 AM	53,3	6 28,3 AM	53,4	1	0,0
2	2,9	9 46,4	−77 27,3	8 47,4	27,2	7 44,6	27,1	6 45,6	27,1	2	3,9
3 - 4	2,2	10 04,3	−18 11,1	9 05,3	11,0	8 02,4	11,0	7 03,5	10,9	3	7.9
4	2,1	11 19,7	+89 05,7	10 20,8	05,7	9 18,2	05,6	8 19,5	05,6	4	11,8
5 - 6	2,2	11 27,4 AM^{3}	+23 17,5	10 28,5 AM$^{2}_{3}$	17,4	9 25,6$^{2}_{3}$	17,5	8 26,6^{3}	17,5	5	15.7
6 - 10	1,1	1 55,7 PM^{1}	+16 26,2	12 56,8 PM	26,2	11 53.9 AM	26,2	10 54,9^{2}	26,3	6.	19,7
7 - 11	0,3	2 34,6	− 8 14,7	1 35,6	14,6	12 32,7 PM	14,6	11 33,7	14,5	7	23,6
8 - 12	0,2	2 35,8	+45 57,9	1 36,8	57,8	12 33,9	57,8	11 34,9 AM	57,8	8	27,5
9 - 16	0,5 v	3 14,9	+ 7 24,0	2 15,9	24,0	1 13,0	24,1	12 14,0 PM	24,1	9	31,5
10 - 17	−0,9	3 44,8	−52 40,8	2 45,8	40,8	1 42,9	40,7	12 43,9	40,6	10	35,4
11 - 18	−1,6	4 05,1	−16 40,1	3 06,1	40,1	2 03,2	40,0	1 04,2	40,0	11	39,3
12 - 20	0,5	4 58,8	+ 5 19,0	3 59,8	19,0	2 56,9	19,1	1 58,0	19,1	12	43,2
13 - 21	1,2	5 04,5	+28 06,9	4 05,5	06,9	3 02,6^{1}	06,9	2 03,6	06,9	13	47,2
14 - 25	2,2	6 46,9	− 8 30,2	5 48,0	30,2	4 45,0	30,2	3 46,1	30,2	14	51,1
15 - 26	1,3	7 27,5	+12 08,6	6 28,5	08,6	5 25,6	08,6	4 26,6	08,6	15	55,0
16 - 28	2,2	9 08,0	+14 46,4	8 09,0	46,4	7 06,1	46,4	6 07,1	46,4	16	0,0
17 - 33	1,2	10 43,8	−10 58,5	9 44,8	58,5	8 41,9	58,5	7 42,9	58,5	17	3,9
18 - 36	2,3	11 24,9	−36 11,7	10 26,0	11,8	9 23,1	11,8	8 24,1	11,8	18	7.9
19 - 37	0,2	11 34,4 PM	+19 22,1	10 35,4	22,1	9 32,5	22,1	8 33,5	22,2	19	11,8
20 - 41	2,3	0 57,2 AM 0 02,2 AM 11 58,3 PM	+26 50,0	11 54,3 PM	50,0	10 51,4	50,1	9 52,4	50,1	20	15,7
May 15										21	19,7
21 - 42	1,2	1 51,1 AM	−26 21,3	0 52,1 AM 0 01,0 AM 11 57,1 PM	21,3	11 45,3 PM	21,3	10 46,3	21,3	22	23,6
May 29										23	27,5
22 - 46	2,1	2 57,0	+12 35,0	1 58,0 AM	35,0	0 55,1 AM 0 00,1 AM 11 56,1 PM	35,0	11 52,2 PM	35,1	24	31,5
June 15										25	35,4
23 - 49	0,1	3 59,3	+38 44,7	3 00,3	44,8	1 57,4 AM	44,8	0 58,4 AM 0 03,4 AM 11 59,5 PM	44,9	26	39,3
June 30										27	43,2
24 - 50	2,1	4 16,5	−26 20,6	3 17,6	20,5	2 14,7	20,5	1 15,7 AM	20,5	28	47,2
25 - 51	0,9	5 12,4	+ 8 46,2	4 13,4	46,2	3 10,5	46,3	2 11,5	46,3	29	51,1
26 - 54	2,5	7 05,5	+ 9 42,4	6 06,5	42,4	5 03,6	42,5	4 04,6	42,5	30	55,0
27 - 56	1,3	8 18,5	−29 48,8	7 19,5	48,7	6 16,6	48,7	5 17,6	48,6	31	59,0
28 - 57	2,6	8 25,8 AM	+15 00,5	7 26,8 AM	00,5	6 23,9 AM	00,6	5 24,9 AM	00,6		
[1] Venus	−4,0	2 59 PM	+27°	2 40 PM	+27°	1 49 PM	+25°	12 24 PM	+23°		
[2] Mars	1,6	10 57 AM	+ 9°	10 41 AM	+13°	10 24 AM	+17°	10 09 AM	+20°		
[3] Jupiter	−1,6	11 33 AM	+12°	10 48 AM	+13°	9 59 AM	+14°	9 13 AM	+15°		
[4] Saturn	1,1	7 46 AM	−12°	6 51 AM	−11°	5 50 AM	−11°	4 52 AM	−11°		

Footnotes indicate near proximity of a planet to a star in time of transit and declination .

For time of transit subsequent to a star's double transit and until the next tabulated date , subtract for the number of days counting from the second transit of that date . All other interpolations may be taken directly by reference to the day of the month .

STAR TABLES , MERIDIAN OF GREENWICH , CIVIL DATE AND MEAN TIME

No.	Mag.	Transit	Decl.	Transit	Decl.	Transit	Decl.	Transit	Decl.	Transit Subtract for day of month	
		July 1		July 16		Aug. 1		Aug. 16			
		h m	° ′	h m	′	h m	′	h m	′		m
1 - 1	2.1	5 29.3 AM	+28 53.4	4 30.4 AM	53.5	3 27.5 AM	53.5	2 28.5 AM	53.6	1	0.0
2	2.9	5 46.7	−77 27.0	4 47.7	27.0	3 44.8	27.0	2 45.9	27.1	2	3.9
3 - 4	2.2	6 04.5	−18 10.9	5 05.5	10.8	4 02.6	10.8	3 03.7	10.7	3	7.9
4	2.1	7 20.8	+89 05.6	6 22.2	05.6	5 19.6	05.6	4 21.0	05.6	4	11.8
5 - 6	2.2	7 27.6[3]	+23 17.5	6 28.6[3]	17.6	5 25.7	17.6	4 26.8	17.6	5	15.7
6 - 10	1.1	9 55.9[1][2]	+16 26.3	8 56.9[1][2]	26.3	7 54.0[1][3]	26.3	6 55.1[3]	26.4	6	19.7
7 - 11	0.3	10 34.8	− 8 14.5	9 35.8	14.4	8 32.9	14.4	7 33.9	14.3	7	23.6
8 - 12	0.2	10 36.0	+45 57.7	9 37.0	57.7	8 34.1	57.7	7 35.1	57.7	8	27.5
9 - 16	0.5 v	11 15.1[1]	+ 7 24.1	10 16.1[1]	24.1	9 13.2[1]	24.2	8 14.2[1]	24.2	9	31.5
10 - 17	−0.9	11 44.9 AM	−52 40.5	10 45.9	40.4	9 43.0	40.4	8 44.0	40.3	10	35.4
11 - 18	−1.6	12 05.3 PM	−16 39.9	11 06.3 AM	39.9	10 03.4	39.8	9 04.4	39.8	11	39.3
12 - 20	0.5	12 59.0	+ 5 19.1	12 00.1 PM	19.1	10 57.1	19.1	9 58.1	19.2	12	43.2
13 - 21	1.2	1 04.7	+28 06.9	12 05.7	06.9	11 02.8 AM	06.9	10 03.8[1][2]	06.9	13	47.2
14 - 25	2.2	2 47.1	− 8 30.2	1 48.1	30.1	12 45.2 PM	30.1	11 46.2 AM	30.1	14	51.1
15 - 26	1.3	3 27.6	+12 08.7	2 28.6	08.7	1 25.7	08.7	12 26.8 PM	08.7	15	55.0
16 - 28	2.2	5 08.1	+14 46.4	4 09.1	46.5	3 06.2	46.5	2 07.2	46.5	16	0.0
17 - 33	1.2	6 43.9	−10 58.5	5 44.9	58.5	4 42.0	58.5	3 43.1	58.5	17	3.9
18 - 36	2.3	7 25.1	−36 11.8	6 26.1	11.8	5 23.2	11.8	4 24.2	11.8	18	7.9
19 - 37	0.2	7 34.5	+19 22.2	6 35.5	22.2	5 32.6	22.2	4 33.7	22.2	19	11.8
20 - 41	2.3	8 53.5	+26 50.2	7 54.5	50.2	6 51.6	50.2	5 52.6	50.3	20	15.7
21 - 42	1.2	9 47.4	−26 21.3	8 48.4	21.3	7 45.5	21.3	6 46.5	21.3	21	19.7
22 - 46	2.1	10 53.2	+12 35.1	9 54.3	35.2	8 51.3	35.2	7 52.4	35.2	22	23.6
23 - 49	0.1	11 55.5 PM	+38 45.0	10 56.5	45.1	9 53.6	45.1	8 54.7	45.2	23	27.5
24 - 50	2.1	0 16.7 AM	−26 20.5	11 13.8 PM	20.5	10 10.9	20.6	9 11.9	20.6	24	31.5
July 5		{ 0 01.0 AM 11 57.1 PM }								25	35.4
25 - 51	0.9	1 12.6 AM	+ 8 46.4	0 13.6 AM	46.4	11 06.7 PM	46.4	10 07.8 PM	46.5	26	39.3
July 19				{ 0 01.8 AM 11 57.9 PM }						27	43.2
26 - 54	2.5	3 05.6	+ 9 42.6	2 06.7 AM	42.6	1 03.8 AM	42.7	0 04.8 AM	42.7	28	47.2
Aug. 17								{ 0 00.9 AM 11 56.9 PM }		29	51.1
27 - 56	1.3	4 18.7	−29 48.6	3 19.7	48.6	2 16.8	48.6	1 17.8 AM	48.6	30	55.0
28 - 57	2.6	4 26.0 AM	+15 00.7	3 27.0 AM	00.7	2 24.1 AM	00.8	1 25.1 AM	00.8	31	59.0
[1] Venus	−4.0	10 50 AM	+19°	9 44 AM	+18°	9 09 AM	+18°	8 57 AM	+19°		
[2] Mars	1.7	9 55 AM	+22°	9 41 AM	+23°	9 25 AM	+24°	9 09 AM	+24°		
[3] Jupiter	−1.9	8 26 AM	+16°	7 37 AM	+17°	6 44 AM	+17°	5 52 AM	+18°		
[4] Saturn	0.8	3 52 AM	−11°	2 51 AM	−11°	1 45 AM	−12°	0 42 AM	−12°		

Footnotes indicate near proximity of a planet to a star in time of transit and declination .

For reduction of time of transit from the Greenwich mean time to the local mean time at the longitude of the station , see table of Sidereal Conversions , page 27 .

STAR TABLES , MERIDIAN OF GREENWICH , CIVIL DATE AND MEAN TIME

No.	Mag.	Tranait	Decl.	Tranait	Decl.	Tranait	Decl.	Transit	Decl.	Tranait Subtract for day of month	
		Sept. 1		Sept. 16		Oct. 1		Oct. 16			
		h m	° ′	h m	′	h m	′	h m	′		m
1 - 1	2.1	1 25.6 AM	+28 53.7	0 26.6 AM	53.7	11 23.7 PM	53.8	10 24.7 PM	53.8	1	0.0
Sept. 22				0 03.0 AM 11 59.1 PM						2	3.9
2	2.9	1 43.0	−77 27.1	0 44.0 AM	27.2	11 41.1 PM	27.3	10 42.1	27.3	3	7.9
Sept. 27				0 00.8 AM 11 56.8 PM						4	11.8
3 - 4	2.2	2 00.8	−18 10.7	1 01.8 AM	10.7	0 02.8 AM 11 58.9 PM	10.8	10 59.9 PM	10.8	5	15.7
4	2.1	3 18.4	+89 05.7	2 19.7	05.8	1 20.9 AM	05.9	0 22.0 AM	05.9	6	19.7
Oct. 21								0 02.4 AM 11 58.5 PM		7	23.6
5 - 6	2.2	3 23.9	+23 17.7	2 24.9	17.7	1 25.9	17.8	0 27.0 AM	17.8	8	27.5
Oct. 22								0 03.4 AM 11 59.4 PM		9	31.5
6 - 10	1.1	5 52.2[3]	+16 26.4	4 53.2[3]	26.4	3 54.2[3]	26.4	2 55.3 AM[3]	26.4	10	35.4
7 - 11	0.3	6 31.0	− 8 14.3	5 32.0	14.3	4 33.1	14.3	3 34.1	14.3	11	39.3
8 - 12	0.2	6 32.2	+45 57.7	5 33.3	57.7	4 34.3	57.7	3 35.3	57.8	12	43.2
9 - 16	0.5 v	7 11.3	+ 7 24.2	6 12.3	24.2	5 13.4	24.2	4 14.4	24.2	13	47.2
10 - 17	−0.9	7 41.1	−52 40.2	6 42.2	40.2	5 43.2	40.2	4 44.2	40.2	14	51.1
11 - 18	−1.6	8 01.5	−16 39.8	7 02.5	39.7	6 03.6	39.7	5 04.6	39.7	15	55.0
12 - 20	0.5	8 55.2	+ 5 19.2	7 56.2[1]	19.2	6 57.3	19.2	5 58.3	19.1	16	0.0
13 - 21	1.2	9 00.9[1][2]	+28 06.9	8 01.9[1][2]	06.8	7 03.0[2]	06.8	6 04.0	06.8	17	3.9
14 - 25	2.2	10 43.3	− 8 30.1	9 44.3	30.0	8 45.4	30.0	7 46.4	30.0	18	7.9
15 - 26	1.3	11 23.8 AM	+12 08.6	10 24.9 AM	08.6	9 25.9[1][2]	08.6	8 26.9[1][2]	08.6	19	11.8
16 - 28	2.2	1 04.3 PM	+14 46.4	12 05.4 PM	46.4	11 06.4 AM	46.4	10 07.4[1]	46.3	20	15.7
17 - 33	1.2	2 40.1	−10 58.5	1 41.2	58.5	12 42.2 PM	58.5	11 43.2 AM	58.5	21	19.7
18 - 36	2.3	3 21.3	−36 11.8	2 22.3	11.7	1 23.3	11.7	12 24.4 PM	11.7	22	23.6
19 - 37	0.2	3 30.7	+19 22.2	2 31.8	22.2	1 32.8	22.2	12 33.8	22.1	23	27.5
20 - 41	2.3	4 49.7	+26 50.3	3 50.7	50.2	2 51.7	50.2	1 52.7	50.2	24	31.5
21 - 42	1.2	5 43.6	−26 21.3	4 44.6	21.3	3 45.6	21.3	2 46.6	21.3	25	35.4
22 - 46	2.1	6 49.5	+12 35.2	5 50.5	35.3	4 51.5	35.2	3 52.5	35.2	26	39.3
23 - 49	0.1	7 51.7	+38 45.2	6 52.8	45.2	5 53.8	45.2	4 54.8	45.2	27	43.2
24 - 50	2.1	8 09.0	−26 20.6	7 10.0	20.6	6 11.1	20.6	5 12.1	20.6	28	47.2
25 - 51	0.9	9 04.9	+ 8 46.5	8 05.9	46.5	7 06.9	46.5	6 07.9	46.5	29	51.1
26 - 54	2.5	10 57.9 PM	+ 9 42.8	9 59.0	42.8	9 00.0	42.8	8 01.0	42.8	30	55.0
27 - 56	1.3	0 14.9 AM	−29 48.6	11 12.0	48.6	10 13.0	48.6	9 14.1	48.7	31	59.0
Sept. 4		0 03.1 AM 11 59.2 PM									
28 - 57	2.6	0 22.2 AM	+15 00.9	11 19.3 PM	00.9	10 20.3 PM	01.0	9 21.3 PM	01.0		
Sept. 6		0 02.5 AM 11 58.6 PM									
[1] Venua	−3.7	8 56 AM	+19°	9 01 AM	+17°	9 09 AM	+13°	9 16 AM	+ 8°		
[2] Mara	1.6	8 50 AM	+23°	8 31 AM	+21°	8 10 AM	+19°	7 46 AM	+17°		
[3] Jupiter	−2.2	4 54 AM	+18°	3 56 AM	+18°	2 55 AM	+18°	1 52 AM	+18°		
[4] Saturn	0.7	11 30 PM	−13°	10 27 PM	−13°	9 25 PM	−13°	8 24 PM	−14°		

Footnotea indicate near proximity of a planet to a atar in time of transit and declination .

For time of tranait aubsequent to a star's double transit and until the next tabulated date , subtract for the number of daya counting from the aecond transit of that date . All other interpolationa may be taken directly by reference to the day of the month .

STAR TABLES , MERIDIAN OF GREENWICH , CIVIL DATE AND MEAN TIME

No.	Mag.	Transit	Decl.	Transit	Decl.	Transit	Decl.	Transit	Decl.	Transit Subtract for day of month	
		Nov. 1		Nov. 16		Dec. 1		Dec. 16			
		h m	° '	h m	'	h m	'	h m	'		m
1 - 1	2.1	9 21.8 PM	+28 53.8	8 22.8 PM	53.9	7 23.9 PM	53.9	6 24.9 PM	53.9	1	0.0
2	2.9	9 39.2	−77 27.4	8 40.2	27.5	7 41.2	27.5	6 42.2	27.5	2	3.9
3 - 4	2.2	9 57.0	−18 10.8	8 58.0	10.9	7 59.0	10.9	7 00.0	10.9	3	7.9
4	2.1	11 15.2	+89 06.1	10 16.2	06.1	9 17.1	06.2	8 17.9	06.3	4	11.8
5 - 6	2.2	11 20.1 PM	+23 17.8	10 21.1 PM[3]	17.9	9 22.2[3]	17.9	8 23.2[3]	17.9	5	15.7
6 - 10	1.1	1 52.4 AM[3]	+16 26.4	0 53.4 AM 0 02.3 AM 11 58.3 PM	26.4	11 50.5 PM	26.4	10 51.5	26.4	6	19.7
Nov. 29										7	23.6
7 - 11	0.3	2 31.2	− 8 14.3	1 32.2 AM	14.4	0 33.3 AM 0 01.8 AM 11 57.9 PM	14.4	11 30.3	14.5	8	27.5
Dec. 9										9	31.5
8 - 12	0.2	2 32.4	+45 57.8	1 33.5	57.8	0 34.5 AM 0 03.0 AM 11 59.1 PM	57.9	11 31.6 PM	57.9	10	35.4
Dec. 9										11	39.3
9 - 16	0.5 v	3 11.5	+ 7 24.2	2 12.5	24.2	1 13.6 AM	24.2	0 14.6 AM 0 02.8 AM 11 58.9 PM	24.1	12	43.2
Dec. 19										13	47.2
10 - 17	−0.9	3 41.3	−52 40.3	2 42.4	40.3	1 43.4	40.4	0 44.4 AM 0 01.2 AM 11 57.2 PM	40.5	14	51.1
Dec. 27										15	55.0
11 - 18	−1.6	4 01.7	−16 39.8	3 02.7	39.8	2 03.8	39.9	1 04.8 AM	39.9	16	0.0
12 - 20	0.5	4 55.4	+ 5 19.1	3 56.4	19.1	2 57.5	19.1	1 58.5	19.0	17	3.9
13 - 21	1.2	5 01.1	+28 06.8	4 02.1	06.8	3 03.2	06.7	2 04.2	06.7	18	7.9
14 - 25	2.2	6 43.5	− 8 30.1	5 44.5	30.1	4 45.6	30.2	3 46.6	30.2	19	11.8
15 - 26	1.3	7 24.0[2]	+12 08.5	6 25.1[2]	08.5	5 26.1[2]	08.4	4 27.1[2]	08.4	20	15.7
16 - 28	2.2	9 04.5	+14 46.3	8 05.5[2]	46.2	7 06.6[2]	46.2	6 07.6[2]	46.1	21	19.7
17 - 33	1.2	10 40.3[1]	−10 58.5	9 41.3[1]	58.5	8 42.4[1]	58.5	7 43.4	58.6	22	23.6
18 - 36	2.3	11 21.5	−36 11.7	10 22.5	11.6	9 23.5	11.6	8 24.5	11.6	23	27.5
19 - 37	0.2	11 30.9 AM	+19 22.1	10 31.9	22.0	9 32.9	21.9	8 34.0	21.9	24	31.5
20 - 41	2.3	12 49.8 PM	+26 50.1	11 50.8 AM	50.0	10 51.9	50.0	9 52.9	49.9	25	35.4
21 - 42	1.2	1 43.7	−26 21.3	12 44.7 PM	21.3	11 45.8 AM	21.3	10 46.8[1]	21.3	26	39.3
22 - 46	2.1	2 49.6	+12 35.2	1 50.6	35.2	12 51.6 PM	35.1	11 52.7 AM	35.1	27	43.2
23 - 49	0.1	3 51.9	+38 45.2	2 52.9	45.2	1 53.9	45.1	12 54.9 PM	45.0	28	47.2
24 - 50	2.1	4 09.2	−26 20.6	3 10.2	20.6	2 11.2	20.6	1 12.2	20.6	29	51.1
25 - 51	0.9	5 05.0	+ 8 46.5	4 06.0	46.5	3 07.0	46.5	2 08.1	46.4	30	55.0
26 - 54	2.5	6 58.1	+ 9 42.8	5 59.1	42.8	5 00.1	42.8	4 01.2	42.8	31	59.0
27 - 56	1.3	8 11.2	−29 48.7	7 12.2	48.7	6 13.2	48.8	5 14.2	48.8		
28 - 57	2.6	8 18.4 PM	+15 01.0	7 19.5 PM	01.0	6 20.5 PM	01.0	5 21.5 PM	01.0		
[1] Venus	−3.4	9 24 AM	+ 1°	9 32 AM	− 6°	9 43 AM	−12°	9 58 AM	−18°		
[2] Mars	1.0	7 18 AM	+14°	6 49 AM	+11°	6 18 AM	+ 9°	5 42 AM	+ 7°		
[3] Jupiter	−2.4	0 41 AM	+17°	11 30 PM	+17°	10 23 PM	+16°	9 18 PM	+16°		
[4] Saturn	1.0	7 20 PM	−14°	6 22 PM	−14°	5 25 PM	−13°	4 29 PM	−13°		

Footnotes indicate near proximity of a planet to a star in time of transit and declination .

For reduction of time of transit from the Greenwich mean time to the local mean time at the longitude of the station , see table of Sidereal Conversions , page 27 .

Mean Time Hour Angle	AZIMUTH OF POLARIS AT ALL HOUR ANGLES , 1964											CORR. TO AZIMUTH		
	Mean Declination + 89°06′ 00″											Add for Decl. + 89°		
												5′50″	5′40″	5′30″
	Latitude											Subtract for Decl. + 89°		
	10°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	6′10″	6′20″	6′30″
h m	′	′	′	′	′	′	′	′	′	′	′	′	′	′
0 00.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0 10.0	2.4	2.4	2.4	2.5	2.5	2.5	2.6	2.6	2.6	2.7	2.7	0.0	0.0	0.0
19.9	4.8	4.8	4.9	4.9	5.0	5.0	5.1	5.2	5.3	5.4	5.5	0.0	0.0	0.0
29.9	7.2	7.2	7.3	7.4	7.4	7.5	7.7	7.8	7.9	8.1	8.2	0.0	0.0	0.1
0 39.9	9.5	9.6	9.7	9.8	9.9	10.0	10.2	10.3	10.5	10.7	10.9	0.0	0.1	0.1
49.9	11.9	12.0	12.1	12.2	12.4	12.5	12.7	12.9	13.1	13.3	13.6	0.0	0.1	0.1
59.8	14.2	14.3	14.5	14.6	14.8	15.0	15.2	15.4	15.7	16.0	16.3	0.0	0.1	0.1
1 09.8	16.5	16.7	16.8	17.0	17.2	17.4	17.6	17.9	18.2	18.5	18.9	0.1	0.1	0.2
19.8	18.8	18.9	19.1	19.3	19.5	19.8	20.0	20.4	20.7	21.1	21.5	0.1	0.1	0.2
29.8	21.0	21.2	21.4	21.6	21.8	22.1	22.4	22.8	23.2	23.6	24.1	0.1	0.1	0.2
1 39.7	23.2	23.4	23.6	23.8	24.1	24.4	24.8	25.1	25.6	26.0	26.6	0.1	0.2	0.2
49.7	25.4	25.6	25.8	26.0	26.3	26.7	27.0	27.5	27.9	28.5	29.0	0.1	0.2	0.2
59.7	27.5	27.7	27.9	28.2	28.5	28.9	29.3	29.7	30.2	30.8	31.4	0.1	0.2	0.3
2 09.6	29.5	29.7	30.0	30.3	30.6	31.0	31.5	32.0	32.5	33.1	33.8	0.1	0.2	0.3
19.6	31.5	31.8	32.0	32.3	32.7	33.1	33.6	34.1	34.7	35.3	36.0	0.1	0.2	0.3
29.6	33.5	33.7	34.0	34.3	34.7	35.1	35.6	36.2	36.8	37.5	38.2	0.1	0.2	0.3
2 39.6	35.3	35.6	35.9	36.2	36.6	37.1	37.6	38.2	38.8	39.6	40.4	0.1	0.2	0.3
49.5	37.1	37.4	37.7	38.1	38.5	39.0	39.5	40.1	40.8	41.6	42.4	0.1	0.2	0.4
59.5	38.9	39.1	39.5	39.9	40.3	40.8	41.4	42.0	42.7	43.5	44.4	0.1	0.3	0.4
3 09.5	40.5	40.8	41.1	41.5	42.0	42.5	43.1	43.8	44.5	45.3	46.3	0.1	0.3	0.4
19.5	42.1	42.4	42.7	43.2	43.6	44.2	44.8	45.5	46.3	47.1	48.0	0.1	0.3	0.4
29.4	43.6	43.9	44.3	44.7	45.2	45.8	46.4	47.1	47.9	48.8	49.7	0.1	0.3	0.4
3 39.4	45.0	45.3	45.7	46.1	46.6	47.2	47.9	48.6	49.4	50.3	51.3	0.1	0.3	0.4
49.4	46.3	46.6	47.0	47.5	48.0	48.6	49.3	50.0	50.9	51.8	52.8	0.1	0.3	0.4
59.3	47.6	47.9	48.3	48.8	49.3	49.9	50.6	51.4	52.2	53.2	54.2	0.2	0.3	0.5
4 09.3	48.7	49.0	49.5	49.9	50.5	51.1	51.8	52.6	53.5	54.5	55.5	0.2	0.3	0.5
19.3	49.8	50.1	50.5	51.0	51.6	52.2	52.9	53.7	54.6	55.6	56.7	0.2	0.3	0.5
29.3	50.7	51.1	51.5	52.0	52.6	53.2	53.9	54.8	55.7	56.7	57.8	0.2	0.3	0.5
4 39.2	51.6	51.9	52.4	52.9	53.4	54.1	54.8	55.7	56.6	57.6	58.8	0.2	0.3	0.5
49.2	52.3	52.7	53.1	53.6	54.2	54.9	55.7	56.5	57.4	58.5	59.6	0.2	0.3	0.5
59.2	53.0	53.4	53.8	54.3	54.9	55.6	56.3	57.2	58.1	59.2	60.4	0.2	0.3	0.5
5 09.2	53.6	53.9	54.4	54.9	55.5	56.2	56.9	57.8	58.8	59.8	61.0	0.2	0.3	0.5
19.1	54.0	54.4	54.8	55.4	56.0	56.6	57.4	58.3	59.2	60.3	61.5	0.2	0.3	0.5
29.1	54.4	54.8	55.2	55.7	56.3	57.0	57.8	58.7	59.6	60.7	61.9	0.2	0.4	0.5
5 39.1	54.6	55.0	55.5	56.0	56.6	57.3	58.1	58.9	59.9	61.0	62.2	0.2	0.4	0.5
49.0	54.8	55.2	55.6	56.1	56.7	57.4	58.2	59.1	60.0	61.1	62.3	0.2	0.4	0.5
56.9	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	62.4	0.2	0.4	0.6
5 57.1	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	61.2	• • •	0.2	0.4	0.6
57.3	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	60.1	• • •	• • •	0.2	0.4	0.6
57.4	• • •	• • •	• • •	• • •	• • •	• • •	• • •	59.1	• • •	• • •	• • •	0.2	0.4	0.5
5 57.6	• • •	• • •	• • •	• • •	• • •	• • •	58.2	• • •	• • •	• • •	• • •	0.2	0.4	0.5
57.7	• • •	• • •	• • •	• • •	• • •	57.5	• • •	• • •	• • •	• • •	• • •	0.2	0.4	0.5
57.9	• • •	• • •	• • •	• • •	56.8	• • •	• • •	• • •	• • •	• • •	• • •	0.2	0.4	0.5
5 58.0	• • •	• • •	• • •	56.2	• • •	• • •	• • •	• • •	• • •	• • •	• • •	0.2	0.3	0.5
58.1	• • •	• • •	55.7	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	0.2	0.3	0.5
58.3	• • •	55.2	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	0.2	0.3	0.5
5 58.4	54.8	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	0.2	0.3	0.5

See footnote pages 18 and 19 for equation to be employed when values in seconds are required.

Mean Time Hour Angle	AZIMUTH OF POLARIS AT ALL HOUR ANGLES , 1964											CORR. TO AZIMUTH		
	Mean Declination + 89°06′ 00″											Add for Decl. + 89°		
												5′50″	5′40″	5′30″
	Latitude											Subtract for Decl. + 89°		
	10°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	6′10″	6′20″	6′30″
h m	′	′	′	′	′	′	′	′	′	′	′	′	′	′
5 56.9	...	...	...	...	...	...	...	...	...	...	62.4	0.2	0.4	0.6
57.1	...	...	...	...	...	...	...	...	...	61.2	...	0.2	0.4	0.6
57.3	...	...	...	...	...	...	...	...	60.1	...	...	0.2	0.4	0.6
5 57.4	...	...	...	...	...	...	...	59.1	...	...	...	0.2	0.4	0.5
57.6	...	...	...	...	...	...	58.2	...	...	...	...	0.2	0.4	0.5
57.7	...	...	...	...	...	57.5	...	...	...	...	...	0.2	0.4	0.5
5 57.9	...	...	...	...	56.8	...	...	...	...	...	...	0.2	0.4	0.5
58.0	...	...	...	56.2	...	...	...	...	...	...	...	0.2	0.3	0.5
58.1	...	...	55.7	...	...	...	...	...	...	...	...	0.2	0.3	0.5
5 58.3	...	55.2	...	...	...	...	...	...	...	...	...	0.2	0.3	0.5
58.4	54.8	...	...	...	...	...	...	...	...	...	...	0.2	0.3	0.5
59.0	54.8	55.2	55.7	56.2	56.8	57.5	58.2	59.1	60.1	61.2	62.4	0.2	0.4	0.5
6 09.0	54.8	55.1	55.6	56.1	56.7	57.4	58.2	59.0	60.0	61.1	62.3	0.2	0.4	0.5
19.0	54.6	55.0	55.4	55.9	56.5	57.2	58.0	58.8	59.8	60.9	62.1	0.2	0.4	0.5
28.9	54.3	54.7	55.1	55.7	56.3	56.9	57.7	58.6	59.5	60.6	61.7	0.2	0.4	0.5
6 38.9	54.0	54.3	54.8	55.3	55.9	56.5	57.3	58.1	59.1	60.1	61.3	0.2	0.3	0.5
48.9	53.5	53.9	54.3	54.8	55.4	56.0	56.8	57.6	58.6	59.6	60.8	0.2	0.3	0.5
58.9	52.9	53.3	53.7	54.2	54.8	55.4	56.2	57.0	57.9	58.9	60.1	0.2	0.3	0.5
7 08.8	52.3	52.6	53.0	53.5	54.1	54.7	55.4	56.3	57.2	58.2	59.3	0.2	0.3	0.5
18.8	51.5	51.8	52.2	52.7	53.3	53.9	54.6	55.4	56.3	57.3	58.4	0.2	0.3	0.5
28.8	50.6	50.9	51.3	51.8	52.4	53.0	53.7	54.5	55.3	56.3	57.4	0.2	0.3	0.5
7 38.7	49.6	50.0	50.4	50.8	51.3	52.0	52.6	53.4	54.3	55.2	56.3	0.2	0.3	0.5
48.7	48.6	48.9	49.3	49.7	50.2	50.8	51.5	52.3	53.1	54.0	55.1	0.2	0.3	0.5
58.7	47.4	47.7	48.1	48.5	49.0	49.6	50.3	51.0	51.8	52.7	53.8	0.2	0.3	0.5
8 08.7	46.2	46.5	46.8	47.3	47.8	48.3	49.0	49.7	50.5	51.4	52.3	0.1	0.3	0.4
18.6	44.8	45.1	45.5	45.9	46.4	46.9	47.5	48.2	49.0	49.9	50.8	0.1	0.3	0.4
28.6	43.4	43.7	44.0	44.4	44.9	45.4	46.0	46.7	47.4	48.3	49.2	0.1	0.3	0.4
8 38.6	41.9	42.2	42.5	42.9	43.4	43.9	44.4	45.1	45.8	46.6	47.5	0.1	0.3	0.4
48.6	40.4	40.6	40.9	41.3	41.7	42.2	42.8	43.4	44.1	44.8	45.7	0.1	0.3	0.4
58.5	38.7	38.9	39.2	39.6	40.0	40.5	41.0	41.6	42.3	43.0	43.8	0.1	0.3	0.4
9 08.5	37.0	37.2	37.5	37.8	38.2	38.7	39.2	39.7	40.4	41.1	41.8	0.1	0.2	0.4
18.5	35.2	35.4	35.7	36.0	36.4	36.8	37.3	37.8	38.4	39.1	39.8	0.1	0.2	0.3
28.4	33.3	33.5	33.8	34.1	34.4	34.8	35.3	35.8	36.4	37.0	37.7	0.1	0.2	0.3
9 38.4	31.4	31.6	31.8	32.1	32.4	32.8	33.2	33.7	34.2	34.8	35.5	0.1	0.2	0.3
48.4	29.4	29.6	29.8	30.1	30.4	30.7	31.1	31.6	32.1	32.6	33.3	0.1	0.2	0.3
58.4	27.4	27.5	27.7	28.0	28.3	28.6	29.0	29.4	29.8	30.4	30.9	0.1	0.2	0.3
10 08.3	25.3	25.4	25.6	25.8	26.1	26.4	26.7	27.1	27.6	28.0	28.6	0.1	0.2	0.2
18.3	23.1	23.3	23.4	23.6	23.9	24.2	24.5	24.8	25.2	25.7	26.1	0.1	0.1	0.2
28.3	20.9	21.1	21.2	21.4	21.6	21.9	22.2	22.5	22.8	23.2	23.7	0.1	0.1	0.2
10 38.3	18.7	18.8	19.0	19.1	19.3	19.6	19.8	20.1	20.4	20.8	21.1	0.1	0.1	0.2
48.2	16.4	16.5	16.7	16.8	17.0	17.2	17.4	17.7	17.9	18.2	18.6	0.1	0.1	0.2
58.2	14.2	14.2	14.4	14.5	14.6	14.8	15.0	15.2	15.4	15.7	16.0	0.0	0.1	0.1
11 08.2	11.8	11.9	12.0	12.1	12.2	12.4	12.5	12.7	12.9	13.1	13.4	0.0	0.1	0.1
18.1	9.5	9.6	9.6	9.7	9.8	9.9	10.1	10.2	10.4	10.5	10.7	0.0	0.1	0.1
28.1	7.1	7.2	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.1	0.0	0.0	0.1
11 38.1	4.8	4.8	4.8	4.9	4.9	5.0	5.0	5.1	5.2	5.3	5.4	0.0	0.0	0.0
48.1	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.6	2.6	2.6	2.7	0.0	0.0	0.0
58.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

See footnote pages 18 and 19 for equation to be employed when values in seconds are required .

Mean Time Hour Angle	AZIMUTH OF POLARIS AT ALL HOUR ANGLES , 1964											CORR. TO AZIMUTH		
	Mean Declination + 89°06′ 00″											Add for Decl. + 89°		
												5′50″	5′40″	5′30″
	Latitude											Subtract for Decl. + 89°		
	30°	32°	34°	36°	38°	40°	42°	44°	46°	48°	50°	6′10″	6′20″	6′30″
h m	′	′	′	′	′	′	′	′	′	′	′	′	′	′
0 00.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0 10.0	2.7	2.8	2.9	2.9	3.0	3.1	3.2	3.3	3.4	3.6	3.7	0.0	0.0	0.0
19.9	5.5	5.6	5.7	5.9	6.0	6.2	6.4	6.6	6.9	7.2	7.5	0.0	0.0	0.1
29.9	8.2	8.4	8.6	8.8	9.1	9.3	9.6	9.9	10.3	10.7	11.2	0.0	0.1	0.1
0 39.9	10.9	11.2	11.4	11.7	12.0	12.4	12.8	13.2	13.7	14.3	14.9	0.0	0.1	0.1
49.9	13.6	13.9	14.2	14.6	15.0	15.5	15.9	16.5	17.1	17.8	18.5	0.0	0.1	0.1
59.8	16.3	16.6	17.0	17.5	18.0	18.5	19.1	19.7	20.4	21.2	22.1	0.1	0.1	0.2
1 09.8	18.9	19.3	19.8	20.3	20.9	21.5	22.2	22.9	23.7	24.7	25.7	0.1	0.1	0.2
19.8	21.5	22.0	22.5	23.1	23.7	24.4	25.2	26.0	27.0	28.1	29.2	0.1	0.2	0.2
29.8	24.1	24.6	25.2	25.8	26.5	27.3	28.2	29.1	30.2	31.4	32.7	0.1	0.2	0.3
1 39.7	26.6	27.2	27.8	28.5	29.3	30.2	31.1	32.2	33.3	34.7	36.1	0.1	0.2	0.3
49.7	29.0	29.7	30.4	31.1	32.0	32.9	34.0	35.1	36.4	37.9	39.4	0.1	0.2	0.3
59.7	31.4	32.1	32.9	33.7	34.6	35.7	36.8	38.0	39.4	41.0	42.7	0.1	0.2	0.3
2 09.6	33.8	34.5	35.3	36.2	37.2	38.3	39.5	40.9	42.4	44.0	45.9	0.1	0.2	0.4
19.6	36.0	36.8	37.7	38.6	39.7	40.9	42.2	43.6	45.2	47.0	48.9	0.1	0.3	0.4
29.6	38.2	39.1	40.0	41.0	42.1	43.4	44.7	46.3	47.9	49.8	51.9	0.1	0.3	0.4
2 39.6	40.4	41.2	42.2	43.3	44.5	45.8	47.2	48.8	50.6	52.6	54.8	0.1	0.3	0.4
49.5	42.4	43.3	44.4	45.5	46.7	48.1	49.6	51.3	53.2	55.2	57.5	0.1	0.3	0.4
59.5	44.4	45.3	46.4	47.6	48.9	50.3	51.9	53.7	55.6	57.8	60.2	0.2	0.3	0.5
3 09.5	46.3	47.3	48.4	49.6	50.9	52.4	54.1	55.9	57.9	60.2	62.7	0.2	0.3	0.5
19.5	48.0	49.1	50.2	51.5	52.9	54.5	56.2	58.1	60.2	62.5	65.1	0.2	0.3	0.5
29.4	49.7	50.8	52.0	53.3	54.8	56.4	58.1	60.1	62.3	64.7	67.4	0.2	0.3	0.5
3 39.4	51.3	52.5	53.7	55.0	56.5	58.2	60.0	62.0	64.3	66.8	69.6	0.2	0.4	0.5
49.4	52.8	54.0	55.2	56.6	58.2	59.9	61.8	63.8	66.1	68.7	71.6	0.2	0.4	0.6
59.3	54.2	55.4	56.7	58.1	59.7	61.5	63.4	65.5	67.9	70.5	73.4	0.2	0.4	0.6
4 09.3	55.5	56.7	58.1	59.5	61.1	62.9	64.9	67.1	69.5	72.2	75.2	0.2	0.4	0.6
19.3	56.7	57.9	59.3	60.8	62.4	64.2	66.2	68.5	70.9	73.7	76.7	0.2	0.4	0.6
29.3	57.8	59.0	60.4	61.9	63.6	65.5	67.5	69.8	72.3	75.1	78.2	0.2	0.4	0.6
4 39.2	58.8	60.0	61.4	63.0	64.7	66.5	68.6	70.9	73.5	76.3	79.4	0.2	0.4	0.6
49.2	59.6	60.9	62.3	63.9	65.6	67.5	69.6	71.9	74.5	77.4	80.6	0.2	0.4	0.6
59.2	60.4	61.7	63.1	64.7	66.4	68.3	70.4	72.8	75.4	78.3	81.5	0.2	0.4	0.6
5 09.2	61.0	62.3	63.7	65.3	67.1	69.0	71.2	73.5	76.2	79.1	82.3	0.2	0.4	0.6
19.1	61.5	62.8	64.3	65.9	67.6	69.6	71.7	74.1	76.8	79.7	83.0	0.2	0.4	0.6
29.1	61.9	63.2	64.7	66.3	68.0	70.0	72.2	74.6	77.2	80.2	83.5	0.2	0.4	0.6
5 39.1	62.2	63.5	64.9	66.6	68.3	70.3	72.5	74.9	77.5	80.5	83.8	0.2	0.4	0.7
49.0	62.3	63.6	65.1	66.7	68.5	70.5	72.6	75.0	77.7	80.7	84.0	0.2	0.4	0.7
54.7	...	...	...	...	...	...	...	...	...	...	84.0	0.3	0.5	0.8
5 55.0	...	...	...	...	...	...	...	...	...	80.7	...	0.2	0.5	0.7
55.3	...	...	...	...	...	...	...	...	77.7	...	...	0.2	0.5	0.7
55.5	...	...	...	...	...	...	...	75.1	...	...	...	0.2	0.5	0.7
5 55.8	...	...	...	...	...	...	72.7	...	...	...	...	0.2	0.4	0.7
56.0	...	...	...	...	...	70.5	...	...	...	...	...	0.2	0.4	0.7
56.2	...	...	...	...	68.5	...	...	...	...	...	...	0.2	0.4	0.6
5 56.4	...	...	...	66.7	...	...	...	...	...	...	...	0.2	0.4	0.6
56.6	...	...	65.1	...	...	...	...	...	...	...	...	0.2	0.4	0.6
56.8	...	63.7	...	...	...	...	...	...	...	...	...	0.2	0.4	0.6
5 56.9	62.4	...	...	...	...	...	...	...	...	...	...	0.2	0.4	0.6

Note : The equation shown on the opposite page may be employed when values in seconds are required , also for stations beyond the limits of the latitude tabulations , where :

A = Azimuth angle

t = Sidereal hour angle

φ = Latitude of station

δ = Declination of Polaris

Mean Time Hour Angle	AZIMUTH OF POLARIS AT ALL HOUR ANGLES , 1964											CORR. TO AZIMUTH		
	Mean Declination + 89°06′ 00″											Add for Decl. + 89°		
												5′50″	5′40″	5′30″
	Latitude											Subtract for Decl. + 89°		
	30°	32°	34°	36°	38°	40°	42°	44°	46°	48°	50°	6′10″	6′20″	6′30″
h m	′	′	′	′	′	′	′	′	′	′	′	′	′	′
5 54.7	...	...	...	...	...	...	...	...	...	...	84.0	0.3	0.5	0.8
55.0	...	...	...	...	...	...	...	...	...	80.7	...	0.2	0.5	0.7
55.3	...	...	...	...	...	...	...	...	77.7	...	...	0.2	0.5	0.7
5 55.5	...	...	...	...	...	...	...	75.1	...	...	...	0.2	0.5	0.7
55.8	...	...	...	...	...	...	72.7	...	...	...	...	0.2	0.4	0.7
56.0	...	...	...	...	...	70.5	...	...	...	...	...	0.2	0.4	0.7
5 56.2	...	...	...	...	68.5	...	...	...	...	...	...	0.2	0.4	0.6
56.4	...	...	...	66.7	...	...	...	...	...	...	...	0.2	0.4	0.6
56.6	...	...	65.1	...	...	...	...	...	...	...	...	0.2	0.4	0.6
5 56.8	...	63.7	...	...	...	...	...	...	...	...	...	0.2	0.4	0.6
56.9	62.4	...	...	...	...	...	...	...	...	...	...	0.2	0.4	0.6
59.0	62.4	63.7	65.1	66.7	68.5	70.5	72.7	75.1	77.7	80.7	84.0	0.2	0.4	0.7
6 09.0	62.3	63.6	65.0	66.6	68.4	70.4	72.5	74.9	77.6	80.6	83.9	0.2	0.4	0.7
19.0	62.1	63.4	64.8	66.4	68.2	70.1	72.3	74.7	77.3	80.3	83.5	0.2	0.4	0.6
28.9	61.7	63.0	64.5	66.1	67.8	69.8	71.9	74.3	76.9	79.8	83.1	0.2	0.4	0.6
6 38.9	61.3	62.6	64.0	65.6	67.3	69.3	71.4	73.7	76.3	79.2	82.5	0.2	0.4	0.6
48.9	60.8	62.0	63.4	65.0	66.7	68.6	70.7	73.0	75.6	78.5	81.7	0.2	0.4	0.6
58.9	60.1	61.3	62.7	64.3	66.0	67.9	69.9	72.2	74.8	77.6	80.7	0.2	0.4	0.6
7 08.8	59.3	60.5	61.9	63.4	65.1	67.0	69.0	71.3	73.8	76.6	79.7	0.2	0.4	0.6
18.8	58.4	59.6	61.0	62.5	64.1	65.9	67.9	70.2	72.6	75.4	78.4	0.2	0.4	0.6
28.8	57.4	58.6	59.9	61.4	63.0	64.8	66.8	69.0	71.4	74.1	77.1	0.2	0.4	0.6
7 38.7	56.3	57.5	58.8	60.2	61.8	63.5	65.5	67.6	70.0	72.6	75.5	0.2	0.4	0.6
48.7	55.1	56.2	57.5	58.9	60.4	62.1	64.0	66.1	68.4	71.0	73.9	0.2	0.4	0.6
58.7	53.8	54.9	56.1	57.5	59.0	60.6	62.5	64.5	66.8	69.3	72.1	0.2	0.4	0.6
8 08.7	52.3	53.4	54.6	56.0	57.4	59.0	60.8	62.8	65.0	67.4	70.1	0.2	0.4	0.5
18.6	50.8	51.9	53.0	54.3	55.7	57.3	59.0	61.0	63.1	65.4	68.1	0.2	0.4	0.5
28.6	49.2	50.2	51.3	52.6	54.0	55.5	57.2	59.0	61.1	63.3	65.9	0.2	0.3	0.5
8 38.6	47.5	48.5	49.6	50.8	52.1	53.5	55.2	57.0	58.9	61.1	63.6	0.2	0.3	0.5
48.6	45.7	46.6	47.7	48.8	50.1	51.5	53.1	54.8	56.7	58.8	61.2	0.2	0.3	0.5
58.5	43.8	44.7	45.7	46.8	48.0	49.4	50.9	52.5	54.3	56.4	58.6	0.2	0.3	0.5
9 08.5	41.8	42.7	43.7	44.7	45.9	47.2	48.6	50.2	51.9	53.8	56.0	0.1	0.3	0.4
18.5	39.8	40.6	41.5	42.5	43.6	44.9	46.2	47.7	49.4	51.2	53.2	0.1	0.3	0.4
28.4	37.7	38.5	39.3	40.3	41.3	42.5	43.7	45.2	46.7	48.5	50.4	0.1	0.3	0.4
9 38.4	35.5	36.2	37.0	37.9	38.9	40.0	41.2	42.5	44.0	45.6	47.5	0.1	0.2	0.4
48.4	33.3	33.9	34.7	35.5	36.4	37.5	38.6	39.8	41.2	42.7	44.4	0.1	0.2	0.3
58.4	30.9	31.6	32.3	33.0	33.9	34.8	35.9	37.0	38.3	39.8	41.3	0.1	0.2	0.3
10 08.3	28.6	29.2	29.8	30.5	31.3	32.2	33.1	34.2	35.4	36.7	38.2	0.1	0.2	0.3
18.3	26.1	26.7	27.3	27.9	28.6	29.4	30.3	31.3	32.4	33.6	34.9	0.1	0.2	0.3
28.3	23.7	24.2	24.7	25.3	25.9	26.7	27.5	28.3	29.3	30.4	31.6	0.1	0.2	0.2
10 38.3	21.1	21.6	22.1	22.6	23.2	23.8	24.5	25.3	26.2	27.2	28.2	0.1	0.1	0.2
48.2	18.6	19.0	19.4	19.9	20.4	20.9	21.6	22.3	23.0	23.9	24.8	0.1	0.1	0.2
58.2	16.0	16.3	16.7	17.1	17.5	18.0	18.6	19.2	19.8	20.5	21.4	0.1	0.1	0.2
11 08.2	13.4	13.7	14.0	14.3	14.7	15.1	15.5	16.0	16.6	17.2	17.9	0.0	0.1	0.1
18.1	10.7	11.0	11.2	11.5	11.8	12.1	12.4	12.8	13.3	13.8	14.3	0.0	0.1	0.1
28.1	8.1	8.2	8.4	8.6	8.8	9.1	9.4	9.7	10.0	10.4	10.8	0.0	0.1	0.1
11 38.1	5.4	5.5	5.6	5.8	5.9	6.1	6.2	6.4	6.7	6.9	7.2	0.0	0.0	0.1
48.1	2.7	2.8	2.8	2.9	3.0	3.0	3.1	3.2	3.3	3.5	3.6	0.0	0.0	0.0
58.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

$$\text{Tan A} = \frac{\sin t}{\cos \varphi \tan \delta - \sin \varphi \cos t}$$

The product " sin φ cos t " is subtracted for hour angles 0° to 90° and added for hour angles from 90° to 180°.

Mean Time Hour Angle	AZIMUTH OF POLARIS AT ALL HOUR ANGLES , 1964												CORR. TO AZIMUTH		
	Mean Declination + 89° 06′ 00″												Add for Decl. + 89°		
													5′50″	5′40″	5′30″
	Latitude												Subtract for Decl.. + 89°		
	50°	52°	54°	56°	58°	60°	61°	62°	63°	64°	65°	Az.	6′10″	6′20″	6′30″
h m	′	′	′	′	′	′	′	′	′	′	′		′	′	′
0 00.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0°	0.0	0.0	0.0
0 10.0	3.7	3.9	4.1	4.3	4.6	4.8	5.0	5.2	5.4	5.6	5.8		0.0	0.0	0.0
19.9	7.5	7.8	8.2	8.6	9.1	9.7	10.0	10.3	10.7	11.1	11.5		0.0	0.1	0.1
29.9	11.2	11.7	12.3	12.9	13.6	14.5	15.0	15.5	16.0	16.6	17.3		0.0	0.1	0.1
0 39.9	14.9	15.5	16.3	17.2	18.1	19.3	19.9	20.6	21.3	22.1	23.0		0.1	0.1	0.2
49.9	18.5	19.4	20.3	21.4	22.6	24.0	24.8	25.6	26.5	27.5	28.6		0.1	0.1	0.2
59.8	22.1	23.2	24.3	25.6	27.0	28.7	29.6	30.6	31.7	32.9	34.2		0.1	0.2	0.2
1 09.8	25.7	26.9	28.2	29.7	31.4	33.3	34.4	35.6	36.9	38.2	39.7		0.1	0.2	0.3
19.8	29.2	30.6	32.1	33.8	35.7	37.9	39.1	40.5	41.9	43.4	45.1		0.1	0.2	0.3
29.8	32.7	34.2	35.9	37.8	39.9	42.4	43.8	45.3	46.9	48.6	50.5		0.1	0.2	0.4
1 39.7	36.1	37.8	39.6	41.7	44.1	46.8	48.3	49.9	51.7	53.6	55.7	0°	0.1	0.3	0.4
49.7	39.4	41.2	43.3	45.5	48.1	51.1	52.8	54.5	56.5	58.6	0.8	1°	0.1	0.3	0.4
59.7	42.7	44.6	46.8	49.3	52.1	55.3	57.1	59.0	1.1	3.4	5.8		0.2	0.3	0.5
2 09.6	45.9	47.9	50.3	52.9	55.9	59.4	1.3	3.4	5.6	8.0	10.7		0.2	0.3	0.5
19.6	48.9	51.2	53.6	56.5	59.7	3.4	5.4	7.6	10.0	12.6	15.4		0.2	0.4	0.6
29.6	51.9	54.3	56.9	59.9	3.3	7.2	9.4	11.7	14.2	16.9	19.9		0.2	0.4	0.6
2 39.6	54.8	57.3	0.0	3.2	6.8	10.9	13.2	15.6	18.3	21.2	24.3		0.2	0.4	0.6
49.5	57.5	0.1	3.1	6.4	10.1	14.5	16.8	19.4	22.2	25.2	28.5		0.2	0.4	0.6
59.5	0.2	2.9	6.0	9.4	13.4	17.9	20.4	23.1	26.0	29.1	32.5		0.2	0.5	0.7
3 09.5	2.7	5.6	8.7	12.3	16.4	21.1	23.7	26.5	29.5	32.8	36.4		0.2	0.5	0.7
19.5	5.1	8.1	11.4	15.1	19.3	24.2	26.9	29.8	32.9	36.3	40.0		0.2	0.5	0.7
29.4	7.4	10.4	13.9	17.7	22.1	27.1	29.9	32.9	36.2	39.7	43.5		0.3	0.5	0.8
3 39.4	9.6	12.7	16.2	20.2	24.7	29.9	32.7	35.8	39.2	42.8	46.7		0.3	0.5	0.8
49.4	11.6	14.8	18.4	22.5	27.1	32.4	35.4	38.6	42.0	45.7	49.7		0.3	0.5	0.8
59.3	13.4	16.7	20.4	24.6	29.4	34.8	37.8	41.1	44.6	48.4	52.5		0.3	0.6	0.8
4 09.3	15.2	18.5	22.3	26.6	31.4	37.0	40.1	43.4	47.0	50.9	55.1		0.3	0.6	0.8
19.3	16.7	20.2	24.0	28.4	33.3	39.0	42.1	45.5	49.2	53.2	57.4		0.3	0.6	0.9
29.3	18.2	21.7	25.6	30.0	35.0	40.8	44.0	47.5	51.2	55.2	59.6	1°	0.3	0.6	0.9
4 39.2	19.4	23.0	27.0	31.5	36.6	42.4	45.7	49.2	52.9	57.0	1.4	2°	0.3	0.6	0.9
49.2	20.6	24.1	28.2	32.7	37.9	43.8	47.1	50.7	54.5	58.6	3.1		0.3	0.6	0.9
59.2	21.5	25.2	29.2	33.8	39.1	45.0	48.4	51.9	55.8	59.9	4.5		0.3	0.6	0.9
5 09.2	22.3	26.0	30.1	34.7	40.0	46.0	49.4	53.0	56.9	1.1	5.6		0.3	0.6	0.9
19.1	23.0	26.7	30.8	35.5	40.8	46.8	50.2	53.8	57.7	2.0	6.5		0.3	0.6	0.9
29.1	23.5	27.2	31.3	36.0	41.3	47.4	50.8	54.4	58.4	2.6	7.2		0.3	0.6	0.9
5 39.1	23.8	27.5	31.7	36.4	41.7	47.8	51.2	54.8	58.8	3.0	7.6		0.3	0.6	0.9
49.0	24.0	27.7	31.9	36.6	41.9	48.0	51.4	55.0	59.0	3.2	7.8		0.3	0.6	0.9
51.3	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	7.8		0.4	0.8	1.2
5 51.7	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	3.2	• • •		0.4	0.8	1.1
52.0	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	59.0	• • •	• • •		0.4	0.7	1.1
52.3	• • •	• • •	• • •	• • •	• • •	• • •	• • •	55.0	• • •	• • •	• • •		0.4	0.7	1.1
5 52.5	• • •	• • •	• • •	• • •	• • •	• • •	51.4	• • •	• • •	• • •	• • •		0.3	0.7	1.0
52.8	• • •	• • •	• • •	• • •	• • •	48.0	• • •	• • •	• • •	• • •	• • •		0.3	0.7	1.0
53.3	• • •	• • •	• • •	• • •	41.9	• • •	• • •	• • •	• • •	• • •	• • •		0.3	0.6	0.9
5 53.7	• • •	• • •	• • •	36.6	• • •	• • •	• • •	• • •	• • •	• • •	• • •		0.3	0.6	0.9
54.1	• • •	• • •	31.9	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •		0.3	0.6	0.9
54.4	• • •	27.7	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •		0.3	0.5	0.8
5 54.7	24.0	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	2°	0.3	0.5	0.8

See footnote pages 18 and 19 for equation to be employed when values in seconds are required .

Mean Time Hour Angle	AZIMUTH OF POLARIS AT ALL HOUR ANGLES , 1964												CORR. TO AZIMUTH		
	Mean Declination + 89°06′ 00″												Add for Decl. + 89°		
													5′50″	5′40″	5′30″
	Latitude												Subtract for Decl. + 89°		
	50°	52°	54°	56°	58°	60°	61°	62°	63°	64°	65°	Az.	6′10″	6′20″	6′30″
h m	′	′	′	′	′	′	′	′	′	′	′		′	′	′
5 51.3	...	...	...	...	...	...	...	...	...	...	7.8	2°	0.4	0.8	1.2
51.7	...	...	...	...	...	...	...	...	...	3.2	...		0.4	0.8	1.1
52.0	...	...	...	...	...	...	...	...	59.0	...	...		0.4	0.7	1.1
5 52.3	...	...	...	...	...	...	...	55.0	...	...	...		0.4	0.7	1.1
52.5	...	...	...	...	...	...	51.4	...	...	...	...		0.3	0.7	1.0
52.8	...	...	...	...	...	48.0	...	...	...	...	...		0.3	0.7	1.0
5 53.3	...	...	...	...	41.9	...	...	...	...	...	...		0.3	0.6	0.9
53.7	...	...	...	36.6	...	...	...	...	...	...	...		0.3	0.6	0.9
54.1	...	...	31.9	...	...	...	...	...	...	...	...		0.3	0.6	0.9
5 54.4	...	27.7	...	...	...	...	...	...	...	...	...		0.3	0.5	0.8
54.7	24.0	...	...	...	...	...	...	...	...	...	...		0.3	0.5	0.8
59.0	24.0	27.7	31.9	36.6	41.9	48.0	51.4	55.0	58.9	3.1	7.7		0.3	0.6	0.9
6 09.0	23.9	27.5	31.7	36.4	41.7	47.7	51.1	54.7	58.6	2.9	7.4		0.3	0.6	0.9
19.0	23.5	27.2	31.3	36.0	41.3	47.3	50.7	54.3	58.1	2.3	6.9		0.3	0.6	0.9
28.9	23.1	26.7	30.8	35.4	40.7	46.7	50.0	53.6	57.4	1.6	6.1		0.3	0.6	0.9
6 38.9	22.5	26.1	30.1	34.7	39.9	45.8	49.1	52.7	56.5	0.6	5.1		0.3	0.6	0.9
48.9	21.7	25.2	29.3	33.8	38.9	44.8	48.1	51.6	55.3	59.4	3.8		0.3	0.6	0.9
58.9	20.7	24.3	28.2	32.7	37.8	43.6	46.8	50.2	54.0	58.0	2.3		0.3	0.6	0.9
7 08.8	19.7	23.1	27.0	31.4	36.4	42.1	45.3	48.7	52.4	56.3	0.6	2°	0.3	0.6	0.9
18.8	18.4	21.8	25.7	30.0	34.9	40.5	43.6	47.0	50.6	54.5	58.7	1°	0.3	0.6	0.9
28.8	17.1	20.4	24.2	28.4	33.2	38.7	41.8	45.1	48.6	52.4	56.5		0.3	0.6	0.9
7 38.7	15.5	18.8	22.5	26.7	31.4	36.8	39.7	42.9	46.4	50.1	54.1		0.3	0.6	0.8
48.7	13.9	17.1	20.7	24.7	29.3	34.6	37.5	40.6	44.0	47.6	51.6		0.3	0.6	0.8
58.7	12.1	15.2	18.7	22.7	27.1	32.3	35.1	38.1	41.4	45.0	48.8		0.3	0.5	0.8
8 08.7	10.1	13.2	16.6	20.4	24.8	29.8	32.5	35.5	38.7	42.1	45.8		0.3	0.5	0.8
18.6	8.1	11.0	14.3	18.1	22.3	27.1	29.8	32.6	35.7	39.1	42.7		0.3	0.5	0.8
28.6	5.9	8.7	11.9	15.5	19.6	24.3	26.9	29.6	32.6	35.8	39.3		0.2	0.5	0.7
8 38.6	3.6	6.3	9.4	12.9	16.8	21.3	23.8	26.5	29.3	32.4	35.8		0.2	0.5	0.7
48.6	1.2	3.8	6.8	10.1	13.9	18.2	20.6	23.1	25.9	28.9	32.1		0.2	0.5	0.7
58.5	58.6	1.1	4.0	7.2	10.8	14.9	17.2	19.7	22.3	25.2	28.2		0.2	0.4	0.7
9 08.5	56.0	58.4	1.1	4.1	7.6	11.5	13.7	16.0	18.6	21.3	24.2		0.2	0.4	0.6
18.5	53.2	55.5	58.1	1.0	4.3	8.0	10.1	12.3	14.7	17.3	20.1		0.2	0.4	0.6
28.4	50.4	52.6	55.0	57.7	0.8	4.4	6.3	8.4	10.7	13.1	15.8		0.2	0.4	0.6
9 38.4	47.5	49.5	51.8	54.4	57.3	0.6	2.4	4.4	6.5	8.8	11.3		0.2	0.4	0.5
48.4	44.4	46.3	48.5	50.9	53.6	56.7	58.4	0.3	2.3	4.4	6.8		0.2	0.3	0.5
58.4	41.3	43.1	45.1	47.3	49.9	52.8	54.4	56.1	57.9	59.9	2.1	1°	0.2	0.3	0.5
10 08.3	38.2	39.8	41.6	43.7	46.0	48.7	50.2	51.8	53.5	55.3	57.3	0°	0.1	0.3	0.4
18.3	34.9	36.4	38.1	40.0	42.1	44.5	45.9	47.3	48.9	50.6	52.4		0.1	0.3	0.4
28.3	31.6	33.0	34.5	36.2	38.1	40.3	41.5	42.8	44.3	45.8	47.4		0.1	0.2	0.4
10 38.3	28.2	29.4	30.8	32.3	34.1	36.0	37.1	38.3	39.5	40.9	42.4		0.1	0.2	0.3
48.2	24.8	25.9	27.1	28.4	29.9	31.7	32.6	33.6	34.7	35.9	37.2		0.1	0.2	0.3
58.2	21.4	22.3	23.3	24.4	25.8	27.2	28.1	28.9	29.9	30.9	32.0		0.1	0.2	0.2
11 08.2	17.9	18.6	19.5	20.4	21.5	22.8	23.5	24.2	25.0	25.9	26.8		0.1	0.1	0.2
18.1	14.3	14.9	15.6	16.4	17.3	18.3	18.8	19.4	20.0	20.7	21.5		0.1	0.1	0.2
28.1	10.8	11.2	11.7	12.3	13.0	13.7	14.1	14.6	15.1	15.6	16.1		0.0	0.1	0.1
11 38.1	7.2	7.5	7.8	8.2	8.7	9.2	9.4	9.7	10.1	10.4	10.8		0.0	0.1	0.1
48.1	3.6	3.8	3.9	4.1	4.3	4.6	4.7	4.9	5.0	5.2	5.4		0.0	0.0	0.0
58.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0°	0.0	0.0	0.0

See footnote pages 18 and 19 for equation to be employed when values in seconds are required .

Lat.	Correction to the Time of Elongation	AZIMUTH OF POLARIS AT ELONGATION , 1964						
		Decl. + 89°						
		5′30″	5′40″	5′50″	6′00″	6′10″	6′20″	6′30″
° ′	W.E. m E.E.	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″
10 00	+2,4–	0 55 20	0 55 10	0 55 00	0 54 50	0 54 40	0 54 30	0 54 20
12 00	2,3	0 55 43	0 55 33	0 55 23	0 55 12	0 55 02	0 54 52	0 54 42
14 00	2,1	0 56 10	0 56 00	0 55 50	0 55 39	0 55 29	0 55 19	0 55 08
16 00	2,0	0 56 42	0 56 31	0 56 21	0 56 11	0 56 00	0 55 50	0 55 39
18 00	1,9	0 57 18	0 57 08	0 56 57	0 56 47	0 56 36	0 56 26	0 56 15
20 00	1,7	0 58 00	0 57 49	0 57 39	0 57 28	0 57 17	0 57 07	0 56 56
21 00	1,6	0 58 23	0 58 12	0 58 01	0 57 51	0 57 40	0 57 29	0 57 18
22 00	1,6	0 58 47	0 58 36	0 58 25	0 58 14	0 58 04	0 57 53	0 57 42
23 00	1,5	0 59 12	0 59 02	0 58 51	0 58 40	0 58 29	0 58 18	0 58 07
24 00	1,4	0 59 39	0 59 29	0 59 18	0 59 07	0 58 56	0 58 45	0 58 34
25 00	1,3	1 00 08	0 59 57	0 59 46	0 59 35	0 59 24	0 59 13	0 59 02
26 00	1,3	1 00 38	1 00 27	1 00 16	1 00 05	0 59 54	0 59 43	0 59 31
27 00	1,2	1 01 10	1 00 59	1 00 48	1 00 36	1 00 25	1 00 14	1 00 03
28 00	1,1	1 01 44	1 01 32	1 01 21	1 01 10	1 00 58	1 00 47	1 00 36
29 00	1,0	1 02 19	1 02 07	1 01 56	1 01 45	1 01 33	1 01 22	1 01 10
30 00	0,9	1 02 56	1 02 44	1 02 33	1 02 21	1 02 10	1 01 58	1 01 47
31 00	0,9	1 03 35	1 03 23	1 03 12	1 03 00	1 02 48	1 02 37	1 02 25
32 00	0,8	1 04 16	1 04 04	1 03 52	1 03 41	1 03 29	1 03 17	1 03 05
33 00	0,7	1 04 59	1 04 47	1 04 35	1 04 23	1 04 11	1 03 59	1 03 48
34 00	0,6	1 05 44	1 05 32	1 05 20	1 05 08	1 04 56	1 04 44	1 04 32
35 00	0,5	1 06 32	1 06 20	1 06 08	1 05 55	1 05 43	1 05 31	1 05 19
36 00	0,4	1 07 22	1 07 10	1 06 57	1 06 45	1 06 33	1 06 20	1 06 08
37 00	0,3	1 08 15	1 08 02	1 07 50	1 07 37	1 07 24	1 07 12	1 06 59
38 00	0,2	1 09 10	1 08 57	1 08 44	1 08 32	1 08 19	1 08 06	1 07 54
39 00	+0,1–	1 10 08	1 09 55	1 09 42	1 09 29	1 09 16	1 09 03	1 08 51
40 00	0,0	1 11 09	1 10 56	1 10 43	1 10 30	1 10 17	1 10 04	1 09 50
41 00	–0,1+	1 12 13	1 12 00	1 11 46	1 11 33	1 11 20	1 11 07	1 10 53
42 00	0,2	1 13 20	1 13 07	1 12 53	1 12 40	1 12 27	1 12 13	1 12 00
43 00	0,3	1 14 31	1 14 18	1 14 04	1 13 50	1 13 37	1 13 23	1 13 09
44 00	0,5	1 15 46	1 15 32	1 15 18	1 15 04	1 14 50	1 14 36	1 14 23
45 00	0,6	1 17 05	1 16 51	1 16 36	1 16 22	1 16 08	1 15 54	1 15 40
46 00	0,7	1 18 28	1 18 13	1 17 59	1 17 44	1 17 30	1 17 16	1 17 01
47 00	0,8	1 19 55	1 19 40	1 19 26	1 19 11	1 18 56	1 18 42	1 18 27
48 00	1,0	1 21 27	1 21 12	1 20 57	1 20 42	1 20 27	1 20 12	1 19 57
49 00	1,1	1 23 05	1 22 49	1 22 34	1 22 19	1 22 04	1 21 48	1 21 33
50 00	1,3	1 24 48	1 24 32	1 24 16	1 24 01	1 23 45	1 23 30	1 23 14
51 00	1,4	1 26 36	1 26 21	1 26 05	1 25 49	1 25 33	1 25 17	1 25 01
52 00	1,6	1 28 32	1 28 15	1 27 59	1 27 43	1 27 27	1 27 10	1 26 54
53 00	1,8	1 30 34	1 30 17	1 30 01	1 29 44	1 29 27	1 29 11	1 28 54
54 00	1,9	1 32 44	1 32 27	1 32 10	1 31 53	1 31 36	1 31 19	1 31 02
55 00	2,1	1 35 02	1 34 44	1 34 27	1 34 09	1 33 52	1 33 34	1 33 17
55 30	2,2	1 36 14	1 35 56	1 35 38	1 35 21	1 35 03	1 34 45	1 34 28
56 00	2,3	1 37 28	1 37 10	1 36 52	1 36 35	1 36 17	1 35 59	1 35 41
56 30	2,4	1 38 45	1 38 27	1 38 09	1 37 51	1 37 33	1 37 15	1 36 56
57 00	2,5	1 40 05	1 39 46	1 39 28	1 39 09	1 38 51	1 38 33	1 38 14
57 30	2,6	1 41 27	1 41 08	1 40 49	1 40 31	1 40 12	1 39 54	1 39 35
58 00	2,7	1 42 51	1 42 33	1 42 14	1 41 55	1 41 36	1 41 17	1 40 58
58 30	2,9	1 44 19	1 44 00	1 43 41	1 43 22	1 43 02	1 42 43	1 42 24
59 00	3,0	1 45 50	1 45 30	1 45 11	1 44 52	1 44 32	1 44 13	1 43 53
59 30	3,1	1 47 24	1 47 04	1 46 44	1 46 25	1 46 05	1 45 45	1 45 25
60 00	3,2	1 49 01	1 48 41	1 48 21	1 48 01	1 47 41	1 47 21	1 47 01
60 30	3,3	1 50 42	1 50 21	1 50 01	1 49 41	1 49 20	1 49 00	1 48 40
61 00	3,5	1 52 26	1 52 05	1 51 45	1 51 24	1 51 03	1 50 43	1 50 22
61 30	3,6	1 54 14	1 53 53	1 53 32	1 53 11	1 52 50	1 52 29	1 52 08
62 00	3,8	1 56 06	1 55 45	1 55 24	1 55 02	1 54 41	1 54 20	1 53 58
62 30	3,9	1 58 03	1 57 41	1 57 20	1 56 58	1 56 36	1 56 15	1 55 53
63 00	4,1	2 00 04	1 59 42	1 59 20	1 58 58	1 58 36	1 58 14	1 57 52
63 30	4,2	2 02 10	2 01 47	2 01 25	2 01 03	2 00 40	2 00 18	1 59 55
64 00	4,4	2 04 21	2 03 58	2 03 35	2 03 12	2 02 49	2 02 27	2 02 04
64 30	4,5	2 06 37	2 06 14	2 05 51	2 05 27	2 05 04	2 04 41	2 04 18
65 00	4,7	2 08 59	2 08 35	2 08 12	2 07 48	2 07 24	2 07 01	2 06 37
65 30	4,9	2 11 27	2 11 03	2 10 39	2 10 15	2 09 50	2 09 26	2 09 02
66 00	5,1	2 14 01	2 13 37	2 13 12	2 12 47	2 12 23	2 11 58	2 11 34
66 30	5,3	2 16 42	2 16 17	2 15 52	2 15 27	2 15 02	2 14 37	2 14 12
67 00	5,5	2 19 31	2 19 05	2 18 40	2 18 14	2 17 48	2 17 23	2 16 57
67 30	5,7	2 22 27	2 22 01	2 21 35	2 21 09	2 20 42	2 20 16	2 19 50
68 00	5,9	2 25 31	2 25 05	2 24 38	2 24 11	2 23 45	2 23 18	2 22 51
68 30	6,1	2 28 45	2 28 17	2 27 50	2 27 23	2 26 55	2 26 28	2 26 01
69 00	6,4	2 32 07	2 31 39	2 31 11	2 30 44	2 30 16	2 29 48	2 29 20
69 30	6,6	2 35 40	2 35 12	2 34 43	2 34 14	2 33 46	2 33 17	2 32 49
70 00	–6,9+	2 39 24	2 38 55	2 38 25	2 37 56	2 37 27	2 36 57	2 36 28

TO FIND THE LATITUDE BY AN ALTITUDE OBSERVATION OF POLARIS AT ANY HOUR ANGLE , 1964

Mean Time Hour Angle	Primary Adjustment to Elevation of Pole								Mean Time Hour Angle
	Subtract Polaris Above the Pole				Add Polaris Below the Pole				
	Decl. + 89°				Decl. + 89°				
	5′30″	5′50″	6′10″	6′30″	5′30″	5′50″	6′10″	6′30″	
h m	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	h m
0 00.0	0 54 30	0 54 10	0 53 50	0 53 30	0 00 00	0 00 00	0 00 00	0 00 00	5 57.2
					0 00 26	0 00 26	0 00 25	0 00 25	5 59.0
0 12.0	0 54 25	0 54 05	0 53 46	0 53 26	0 01 52	0 01 51	0 01 50	0 01 49	6 05.0
23.9	54 12	53 52	53 32	53 12	03 17	03 16	03 14	03 13	11.0
35.9	53 49	53 29	53 10	52 50	04 42	04 40	04 39	04 37	17.0
47.9	53 17	52 58	52 38	52 19	06 07	06 05	06 03	06 00	23.0
59.8	52 37	52 18	51 58	51 39	07 32	07 29	07 26	07 24	28.9
1 11.8	0 51 47	0 51 29	0 51 10	0 50 51	0 08 57	0 08 53	0 08 50	0 08 47	6 34.9
23.8	50 50	50 31	50 12	49 54	10 21	10 17	10 13	10 09	40.9
35.7	49 43	49 25	49 07	48 48	11 45	11 40	11 36	11 31	46.9
47.7	48 28	48 11	47 53	47 35	13 08	13 03	12 58	12 53	52.9
59.7	47 05	46 48	46 31	46 14	14 31	14 25	14 20	14 14	58.9
2 11.6	0 45 35	0 45 18	0 45 01	0 44 45	0 15 53	0 15 47	0 15 41	0 15 35	7 04.8
23.6	43 57	43 41	43 24	43 08	17 14	17 08	17 01	16 55	10.8
35.6	42 11	41 56	41 40	41 25	18 35	18 28	18 21	18 14	16.8
47.5	40 19	40 04	39 49	39 34	19 55	19 47	19 40	19 32	22.8
59.5	38 19	38 05	37 51	37 37	21 14	21 06	20 58	20 50	28.8
3 05.5	0 37 17	0 37 04	0 36 50	0 36 37	0 22 32	0 22 23	0 22 15	0 22 07	7 34.8
11.5	36 14	36 01	35 47	35 34	23 49	23 40	23 31	23 22	40.7
17.5	35 09	34 56	34 43	34 30	25 05	24 56	24 47	24 37	46.7
23.4	34 02	33 50	33 38	33 25	26 20	26 11	26 01	25 51	52.7
29.4	32 54	32 42	32 30	32 19	27 35	27 24	27 14	27 04	58.7
3 35.4	0 31 45	0 31 34	0 31 22	0 31 11	0 28 48	0 28 37	0 28 26	0 28 15	8 04.7
41.4	30 35	30 24	30 12	30 01	29 59	29 48	29 37	29 26	10.7
47.4	29 23	29 12	29 01	28 51	31 10	30 58	30 47	30 35	16.6
53.4	28 10	28 00	27 49	27 39	32 19	32 07	31 55	31 43	22.6
59.3	26 56	26 46	26 36	26 26	33 27	33 15	33 02	32 50	28.6
4 05.3	0 25 40	0 25 31	0 25 22	0 25 12	0 34 34	0 34 21	0 34 08	0 33 55	8 34.6
11.3	24 24	24 15	24 06	23 58	35 39	35 26	35 12	34 59	40.6
17.3	23 07	22 58	22 50	22 42	36 42	36 29	36 15	36 02	46.6
23.3	21 48	21 41	21 33	21 25	37 45	37 31	37 17	37 03	52.5
29.3	20 29	20 22	20 15	20 07	38 45	38 31	38 17	38 02	58.5
4 35.2	0 19 09	0 19 02	0 18 56	0 18 49	0 40 42	0 40 27	0 40 12	0 39 57	9 10.5
41.2	17 49	17 42	17 36	17 29	42 32	42 16	42 00	41 45	22.5
47.2	16 27	16 21	16 15	16 09	44 15	43 58	43 42	43 26	34.4
53.2	15 05	15 00	14 54	14 49	45 50	45 33	45 16	45 00	46.4
59.2	13 42	13 37	13 32	13 28	47 18	47 01	46 44	46 26	58.4
5 05.2	0 12 19	0 12 15	0 12 10	0 12 06	0 48 39	0 48 21	0 48 03	0 47 45	10 10.3
11.1	10 55	10 51	10 47	10 44	49 52	49 33	49 15	48 57	22.3
17.1	09 31	09 28	09 24	09 21	50 56	50 37	50 19	50 00	34.3
23.1	08 06	08 03	08 01	07 58	51 52	51 33	51 14	50 55	46.2
29.1	06 41	06 39	06 37	06 34	52 40	52 21	52 02	51 42	58.2
5 35.1	0 05 16	0 05 14	0 05 13	0 05 11	0 53 20	0 53 00	0 52 41	0 52 21	11 10.2
41.1	03 51	03 50	03 48	03 47	53 50	53 31	53 11	52 51	22.1
47.0	02 25	02 25	02 24	02 23	54 12	53 52	53 33	53 13	34.1
53.0	01 00	00 59	00 59	00 59	54 26	54 06	53 46	53 26	46.1
57.2	00 00	00 00	00 00	00 00	54 30	54 10	53 50	53 30	58.0

Mean Time Hour Angle	Supplemental Correction to be Applied to the Vertical Angle Reading													Mean Time Hour Angle
	Altitude													
	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°	
h m	″	″	″	″	″	″	″	″	″	″	″	″	″	h m
0 00	0	0	0	0	0	0	0	0	0	0	0	0	0	11 58
1 00	− 1	− 1	− 1	− 1	− 1	− 1	0	0	0	+ 1	+ 1	+ 2	+ 3	10 58
2 00	5	5	4	3	3	2	− 1	0	+ 1	3	5	7	11	9 58
3 00	10	9	8	7	5	4	2	0	2	5	9	15	22	8 58
3 59	16	14	12	10	8	6	3	0	4	8	14	22	33	7 59
4 59	20	17	15	13	10	7	4	0	5	10	17	27	42	6 59
5 59	−21	−19	−16	−14	−11	− 8	− 4	0	+ 5	+11	+19	+29	+44	5 59

EXPLANATIONS FOR THE STELLAR OBSERVATIONS

The data in this Ephemeris are arranged for the surveying practice of the Bureau of Land Management; the methods are useful in any survey where field observations are to be made for the ascertainment of the direction of a line in terms of angular value referred to the true meridian at that place.

In most cases, data are available as to the approximate latitude and longitude of the observing station, and preliminary determinations are made for the meridian and watch correction in terms of local mean time. The observations of the stars then follow on an observing program arranged for what is needed, and to suit the time of year, the latitude of the station, and other conditions that are factors.

A complete and well balanced stellar observing program will include: (1) the meridian passage of one star for time and latitude; (2) Polaris for azimuth and latitude; and (3) two well placed stars, one easterly and one westerly, both for azimuth, and one or both for time. The necessary verifications are thus accomplished. Instrumental uncertainties in the vertical angle readings are made apparent by this plan, and are compensated by taking the means of offsetting values. An observation may be made to verify only one or two values when the remainder are already well determined.

There are six stellar observing periods: (1) late afternoon, daylight; (2) early evening, twilight; (3) later p. m., after dark, illumination required; (4) after midnight, ditto; (5) early morning, twilight; and (6) after sunrise, daylight. The stars to be observed are chosen after deciding upon the observing period, and making the selection according to the desired position in hour angle and declination.

The time of a star's transit is to be reduced from the tabulated value for the Greenwich meridian to the longitude of the station; this is 10 seconds of time for each 15° (or one hour) of longitude, subtracted for west longitude (see table of Sidereal Conversions, page 27); this will give the correct local mean time at the moment of the star's meridian passage. The next step is to anticipate the probable local mean time of each observation, and the star's hour angle at that moment, to the east or to the west of the meridian.

The setting positions for the instrument in vertical angle (v) and in horizontal angle (A) are computed on the basis of the assumed hour angle (t), the star's declination (δ), and the known or approximate latitude (φ). This is done to secure a setting that is sufficiently accurate to bring the star within the field of the telescope, especially if the observation is to be by daylight, or twilight; less accuracy is needed just for the star's identification if the observation is to be made during starlight. The preliminary computations may be made with 4-place tables. The true values are obtained by reduction of the observations. The reductions for stellar observations are similar to the methods applicable to observations of the sun, and employ the same equations.

In all stellar observations, the true vertical angle (h) is equal to the observed vertical angle (v) minus the refraction (r) in zenith distance; there is no correction for parallax. In observations of the sun, the true vertical angle (h) is equal to (v) minus (r) plus parallax; see table, page 25.

In observations of the sun, the meridian passage and the hour angle (t) are in apparent solar time. The equation of time is applied to give the watch correction in terms of local mean time.

In observations of a star, the hour angle (t) is in terms of a sidereal rate; a subtraction of 10 seconds per hour will give the equivalent mean time hour angle. (Sidereal Conversions, page 27).

The following equations are regarded as the most useful for the methods stated above:

On the meridian, the vertical angle: $h = 90° - \varphi \pm \delta$; (or) $\varphi = 90° - h \pm \delta$

At any hour angle: $\sin h = \cos t \cos \varphi \cos \delta + \sin \varphi \sin \delta$

$$: \cos t = \frac{\sin h}{\cos \varphi \cos \delta} - \tan \varphi \tan \delta$$

$$: \cos A = \frac{\sin \delta}{\cos \varphi \cos h} - \tan \varphi \tan h$$

The product "$\sin \varphi \sin \delta$" and the fraction "$\frac{\sin \delta}{\cos \varphi \cos h}$" are negative for south declinations.

The product "$\cos t \cos \varphi \cos \delta$" is negative for hour angles exceeding six hours or 90°.

The product "$\tan \varphi \tan \delta$" is subtracted for north declinations; added for south declinations.

If the result for "cos A" is $\left\{\begin{matrix}\text{positive}\\ \text{negative}\end{matrix}\right\}$ the horizontal angle counts from the $\left\{\begin{matrix}\text{north.}\\ \text{south.}\end{matrix}\right.$

If the result for "cos t" is $\left\{\begin{matrix}\text{positive}\\ \text{negative}\end{matrix}\right\}$ the hour angle is $\left\{\begin{matrix}\text{less}\\ \text{more}\end{matrix}\right\}$ than six hours or 90°.

By a stellar equal-altitude observation, the meridian is determined as the mean of two direction-pointings; the latitude is not required; there are no corrections as to declination. A mean of the watch readings at the moment of each observation is equivalent to a reading at the time of the star's meridian passage. The latitude may be reduced from the maximum vertical angle at meridian passage.

The equations as written and explained above are applicable for the northern latitudes; suitable transpositions are required for observations in the southern latitudes.

MEAN REFRACTIONS IN ZENITH DISTANCE AND SUN'S PARALLAX IN ALTITUDE

Bar. : 29.6 ins. Temp. : 50° F.

Apparent Altitude	Refraction	Sun's Par.	Apparent Altitude	Refraction	Sun's Par.	Apparent Altitude	Refraction	Sun's Par.
° '	' "	"	° '	' "	"	°	' "	"
7 30	6 53	8.8	12 0	4 25	8.7	25	2 3	8.1
7 40	6 45	8.8	12 30	4 15	8.7	26	1 58	8.0
7 50	6 37	8.8	13 0	4 5	8.7	27	1 53	7.9
8 0	6 30	8.8	13 30	3 56	8.7	28	1 48	7.9
8 10	6 22	8.8	14 0	3 47	8.6	29	1 44	7.8
8 20	6 15	8.8	14 30	3 39	8.6	30	1 40	7.7
8 30	6 8	8.8	15 0	3 32	8.6	32	1 32	7.6
8 40	6 2	8.8	15 30	3 25	8.6	34	1 25	7.4
8 50	5 55	8.8	16 0	3 19	8.6	36	1 19	7.2
9 0	5 49	8.8	16 30	3 13	8.5	38	1 14	7.0
9 10	5 43	8.8	17 0	3 7	8.5	40	1 9	6.8
9 20	5 38	8.8	17 30	3 1	8.5	42	1 4	6.6
9 30	5 32	8.8	18 0	2 56	8.5	44	1 0	6.4
9 40	5 26	8.8	18 30	2 51	8.4	46	0 56	6.2
9 50	5 21	8.8	19 0	2 46	8.4	48	0 52	6.0
10 0	5 16	8.8	19 30	2 42	8.4	50	0 48	5.7
10 20	5 6	8.8	20 0	2 37	8.4	55	0 40	5.1
10 40	4 57	8.7	21 0	2 29	8.3	60	0 33	4.4
11 0	4 48	8.7	22 0	2 22	8.2	65	0 27	3.8
11 20	4 40	8.7	23 0	2 15	8.2	70	0 21	3.0
11 40	4 32	8.7	24 0	2 9	8.1	80	0 10	1.5
12 0	4 25	8.7	25 0	2 3	8.1	90	0 0	0.0

Apparent altitude (observed vertical angle) : v
Sun's true altitude : h = v - refraction + parallax
Star's true altitude : h = v - refraction

True refraction : mean refraction x coefficient for barometric pressure x coefficient for temperature.

COEFFICIENTS TO APPLY TO MEAN REFRACTIONS FOR VARIATIONS IN BAROMETER AND TEMPERATURE

Barometer (Ins.)	Elevation above sea level (Feet)	Coefficient	Barometer (Ins.)	Elevation above sea level (Feet)	Coefficient	Barometer (Ins.)	Elevation above sea level (Feet)	Coefficient	Temperature (Fahr.)	Coefficient
30.5	-451	1.03	27.2	2,670	0.92	23.6	6,538	0.80	-10°	1.13
30.2	-181	1.02	26.9	2,972	.91	23.3	6,887	.79	0°	1.11
30.0	00	1.01	26.6	3,277	.90	23.0	7,239	.78	+10°	1.08
29.9	+ 91	1.01	26.3	3,586	.89	22.7	7,597	.77	20°	1.06
29.6	366	1.00	26.0	3,899	.88	22.4	7,960	.76	30°	1.04
29.3	643	.99	25.7	4,215	.87	22.1	8,327	.75	40°	1.02
29.0	924	.98	25.4	4,535	.86	21.8	8,700	.74	50°	1.00
28.7	1,207	.97	25.1	4,859	.85	21.5	9,077	.73	60°	.98
28.4	1,493	.96	24.8	5,186	.84	21.2	9,460	.72	70°	.96
28.1	1,783	.95	24.5	5,518	.83	20.9	9,848	.71	80°	.94
27.8	2,075	.94	24.2	5,854	.82	20.6	10,242	.70	90°	.93
27.5	2,371	.93	23.9	6,194	.81	20.3	10,642	.69	100°	.91
27.2	2,670	.92	23.6	6,538	.80	20.0	11,047	.68	+110°	.90

CONVERSION OF TIME TO ARC

Minutes	Hours												
	0	1	2	3	4	5	6	7	8	9	10	11	12
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
0	0 00	15 00	30 00	45 00	60 00	75 00	90 00	105 00	120 00	135 00	150 00	165 00	180 00
1	0 15	15 15	30 15	45 15	60 15	75 15	90 15	105 15	120 15	135 15	150 15	165 15	180 15
2	0 30	15 30	30 30	45 30	60 30	75 30	90 30	105 30	120 30	135 30	150 30	165 30	180 30
3	0 45	15 45	30 45	45 45	60 45	75 45	90 45	105 45	120 45	135 45	150 45	165 45	180 45
4	1 00	16 00	31 00	46 00	61 00	76 00	91 00	106 00	121 00	136 00	151 00	166 00	181 00
5	1 15	16 15	31 15	46 15	61 15	76 15	91 15	106 15	121 15	136 15	151 15	166 15	181 15
6	1 30	16 30	31 30	46 30	61 30	76 30	91 30	106 30	121 30	136 30	151 30	166 30	181 30
7	1 45	16 45	31 45	46 45	61 45	76 45	91 45	106 45	121 45	136 45	151 45	166 45	181 45
8	2 00	17 00	32 00	47 00	62 00	77 00	92 00	107 00	122 00	137 00	152 00	167 00	182 00
9	2 15	17 15	32 15	47 15	62 15	77 15	92 15	107 15	122 15	137 15	152 15	167 15	182 15
10	2 30	17 30	32 30	47 30	62 30	77 30	92 30	107 30	122 30	137 30	152 30	167 30	182 30
11	2 45	17 45	32 45	47 45	62 45	77 45	92 45	107 45	122 45	137 45	152 45	167 45	182 45
12	3 00	18 00	33 00	48 00	63 00	78 00	93 00	108 00	123 00	138 00	153 00	168 00	183 00
13	3 15	18 15	33 15	48 15	63 15	78 15	93 15	108 15	123 15	138 15	153 15	168 15	183 15
14	3 30	18 30	33 30	48 30	63 30	78 30	93 30	108 30	123 30	138 30	153 30	168 30	183 30
15	3 45	18 45	33 45	48 45	63 45	78 45	93 45	108 45	123 45	138 45	153 45	168 45	183 45
16	4 00	19 00	34 00	49 00	64 00	79 00	94 00	109 00	124 00	139 00	154 00	169 00	184 00
17	4 15	19 15	34 15	49 15	64 15	79 15	94 15	109 15	124 15	139 15	154 15	169 15	184 15
18	4 30	19 30	34 30	49 30	64 30	79 30	94 30	109 30	124 30	139 30	154 30	169 30	184 30
19	4 45	19 45	34 45	49 45	64 45	79 45	94 45	109 45	124 45	139 45	154 45	169 45	184 45
20	5 00	20 00	35 00	50 00	65 00	80 00	95 00	110 00	125 00	140 00	155 00	170 00	185 00
21	5 15	20 15	35 15	50 15	65 15	80 15	95 15	110 15	125 15	140 15	155 15	170 15	185 15
22	5 30	20 30	35 30	50 30	65 30	80 30	95 30	110 30	125 30	140 30	155 30	170 30	185 30
23	5 45	20 45	35 45	50 45	65 45	80 45	95 45	110 45	125 45	140 45	155 45	170 45	185 45
24	6 00	21 00	36 00	51 00	66 00	81 00	96 00	111 00	126 00	141 00	156 00	171 00	186 00
25	6 15	21 15	36 15	51 15	66 15	81 15	96 15	111 15	126 15	141 15	156 15	171 15	186 15
26	6 30	21 30	36 30	51 30	66 30	81 30	96 30	111 30	126 30	141 30	156 30	171 30	186 30
27	6 45	21 45	36 45	51 45	66 45	81 45	96 45	111 45	126 45	141 45	156 45	171 45	186 45
28	7 00	22 00	37 00	52 00	67 00	82 00	97 00	112 00	127 00	142 00	157 00	172 00	187 00
29	7 15	22 15	37 15	52 15	67 15	82 15	97 15	112 15	127 15	142 15	157 15	172 15	187 15
30	7 30	22 30	37 30	52 30	67 30	82 30	97 30	112 30	127 30	142 30	157 30	172 30	187 30
31	7 45	22 45	37 45	52 45	67 45	82 45	97 45	112 45	127 45	142 45	157 45	172 45	187 45
32	8 00	23 00	38 00	53 00	68 00	83 00	98 00	113 00	128 00	143 00	158 00	173 00	188 00
33	8 15	23 15	38 15	53 15	68 15	83 15	98 15	113 15	128 15	143 15	158 15	173 15	188 15
34	8 30	23 30	38 30	53 30	68 30	83 30	98 30	113 30	128 30	143 30	158 30	173 30	188 30
35	8 45	23 45	38 45	53 45	68 45	83 45	98 45	113 45	128 45	143 45	158 45	173 45	188 45
36	9 00	24 00	39 00	54 00	69 00	84 00	99 00	114 00	129 00	144 00	159 00	174 00	189 00
37	9 15	24 15	39 15	54 15	69 15	84 15	99 15	114 15	129 15	144 15	159 15	174 15	189 15
38	9 30	24 30	39 30	54 30	69 30	84 30	99 30	114 30	129 30	144 30	159 30	174 30	189 30
39	9 45	24 45	39 45	54 45	69 45	84 45	99 45	114 45	129 45	144 45	159 45	174 45	189 45
40	10 00	25 00	40 00	55 00	70 00	85 00	100 00	115 00	130 00	145 00	160 00	175 00	190 00
41	10 15	25 15	40 15	55 15	70 15	85 15	100 15	115 15	130 15	145 15	160 15	175 15	190 15
42	10 30	25 30	40 30	55 30	70 30	85 30	100 30	115 30	130 30	145 30	160 30	175 30	190 30
43	10 45	25 45	40 45	55 45	70 45	85 45	100 45	115 45	130 45	145 45	160 45	175 45	190 45
44	11 00	26 00	41 00	56 00	71 00	86 00	101 00	116 00	131 00	146 00	161 00	176 00	191 00
45	11 15	26 15	41 15	56 15	71 15	86 15	101 15	116 15	131 15	146 15	161 15	176 15	191 15
46	11 30	26 30	41 30	56 30	71 30	86 30	101 30	116 30	131 30	146 30	161 30	176 30	191 30
47	11 45	26 45	41 45	56 45	71 45	86 45	101 45	116 45	131 45	146 45	161 45	176 45	191 45
48	12 00	27 00	42 00	57 00	72 00	87 00	102 00	117 00	132 00	147 00	162 00	177 00	192 00
49	12 15	27 15	42 15	57 15	72 15	87 15	102 15	117 15	132 15	147 15	162 15	177 15	192 15
50	12 30	27 30	42 30	57 30	72 30	87 30	102 30	117 30	132 30	147 30	162 30	177 30	192 30
51	12 45	27 45	42 45	57 45	72 45	87 45	102 45	117 45	132 45	147 45	162 45	177 45	192 45
52	13 00	28 00	43 00	58 00	73 00	88 00	103 00	118 00	133 00	148 00	163 00	178 00	193 00
53	13 15	28 15	43 15	58 15	73 15	88 15	103 15	118 15	133 15	148 15	163 15	178 15	193 15
54	13 30	28 30	43 30	58 30	73 30	88 30	103 30	118 30	133 30	148 30	163 30	178 30	193 30
55	13 45	28 45	43 45	58 45	73 45	88 45	103 45	118 45	133 45	148 45	163 45	178 45	193 45
56	14 00	29 00	44 00	59 00	74 00	89 00	104 00	119 00	134 00	149 00	164 00	179 00	194 00
57	14 15	29 15	44 15	59 15	74 15	89 15	104 15	119 15	134 15	149 15	164 15	179 15	194 15
58	14 30	29 30	44 30	59 30	74 30	89 30	104 30	119 30	134 30	149 30	164 30	179 30	194 30
59	14 45	29 45	44 45	59 45	74 45	89 45	104 45	119 45	134 45	149 45	164 45	179 45	194 45
60	15 00	30 00	45 00	60 00	75 00	90 00	105 00	120 00	135 00	150 00	165 00	180 00	195 00

Note : To convert seconds of time , use the first column for the number of seconds and the second column for the converted value in minutes and seconds of arc ; for example 33 seconds of time = 8′15″ in arc .

CONVERSION OF ARC TO TIME

°	h m	°	h m	°	h m	°	h m	°	h m	°	h m	″	s
′	m s	′	m s										
0	0 00	30	2 00	60	4 00	90	6 00	120	8 00	150	10 00	0	0.00
1	0 04	31	2 04	61	4 04	91	6 04	121	8 04	151	10 04	2	0.13
2	0 08	32	2 08	62	4 08	92	6 08	122	8 08	152	10 08	4	0.27
3	0 12	33	2 12	63	4 12	93	6 12	123	8 12	153	10 12	6	0.40
4	0 16	34	2 16	64	4 16	94	6 16	124	8 16	154	10 16	8	0.53
5	0 20	35	2 20	65	4 20	95	6 20	125	8 20	155	10 20	10	0.67
6	0 24	36	2 24	66	4 24	96	6 24	126	8 24	156	10 24	12	0.80
7	0 28	37	2 28	67	4 28	97	6 28	127	8 28	157	10 28	14	0.93
8	0 32	38	2 32	68	4 32	98	6 32	128	8 32	158	10 32	16	1.07
9	0 36	39	2 36	69	4 36	99	6 36	129	8 36	159	10 36	18	1.20
10	0 40	40	2 40	70	4 40	100	6 40	130	8 40	160	10 40	20	1.33
11	0 44	41	2 44	71	4 44	101	6 44	131	8 44	161	10 44	22	1.47
12	0 48	42	2 48	72	4 48	102	6 48	132	8 48	162	10 48	24	1.60
13	0 52	43	2 52	73	4 52	103	6 52	133	8 52	163	10 52	26	1.73
14	0 56	44	2 56	74	4 56	104	6 56	134	8 56	164	10 56	28	1.87
15	1 00	45	3 00	75	5 00	105	7 00	135	9 00	165	11 00	30	2.00
16	1 04	46	3 04	76	5 04	106	7 04	136	9 04	166	11 04	32	2.13
17	1 08	47	3 08	77	5 08	107	7 08	137	9 08	167	11 08	34	2.27
18	1 12	48	3 12	78	5 12	108	7 12	138	9 12	168	11 12	36	2.40
19	1 16	49	3 16	79	5 16	109	7 16	139	9 16	169	11 16	38	2.53
20	1 20	50	3 20	80	5 20	110	7 20	140	9 20	170	11 20	40	2.67
21	1 24	51	3 24	81	5 24	111	7 24	141	9 24	171	11 24	42	2.80
22	1 28	52	3 28	82	5 28	112	7 28	142	9 28	172	11 28	44	2.93
23	1 32	53	3 32	83	5 32	113	7 32	143	9 32	173	11 32	46	3.07
24	1 36	54	3 36	84	5 36	114	7 36	144	9 36	174	11 36	48	3.20
25	1 40	55	3 40	85	5 40	115	7 40	145	9 40	175	11 40	50	3.33
26	1 44	56	3 44	86	5 44	116	7 44	146	9 44	176	11 44	52	3.47
27	1 48	57	3 48	87	5 48	117	7 48	147	9 48	177	11 48	54	3.60
28	1 52	58	3 52	88	5 52	118	7 52	148	9 52	178	11 52	56	3.73
29	1 56	59	3 56	89	5 56	119	7 56	149	9 56	179	11 56	58	3.87
30	2 00	60	4 00	90	6 00	120	8 00	150	10 00	180	12 00	60	4.00

Degrees of arc convert to hours and minutes of time ; minutes of arc convert to minutes and seconds of time . See right hand column for conversion of seconds of arc to seconds of time .

SIDEREAL CONVERSIONS

Long.	Hours	Longitude						
		0° 00′	2° 30′	5° 00′	7° 30′	10° 00′	12° 30′	15° 00′
		Minutes						
		0	10	20	30	40	50	60
°		m s	m s	m s	m s	m s	m s	m s
0	0	0 00	0 02	0 03	0 05	0 07	0 08	0 10
15	1	0 10	0 11	0 13	0 15	0 16	0 18	0 20
30	2	0 20	0 21	0 23	0 25	0 26	0 28	0 30
45	3	0 30	0 31	0 33	0 34	0 36	0 38	0 39
60	4	0 39	0 41	0 43	0 44	0 46	0 48	0 49
75	5	0 49	0 51	0 53	0 54	0 56	0 57	0 59
90	6	0 59	1 01	1 02	1 04	1 06	1 07	1 09
105	7	1 09	1 11	1 12	1 14	1 15	1 17	1 19
120	8	1 19	1 20	1 22	1 24	1 25	1 27	1 29
135	9	1 29	1 30	1 32	1 34	1 35	1 37	1 38
150	10	1 38	1 40	1 42	1 43	1 45	1 47	1 48
165	11	1 48	1 50	1 52	1 53	1 55	1 56	1 58
180	12	1 58	2 00	2 01	2 03	2 05	2 06	2 08

Sidereal into mean solar time :	To be subtracted from a sidereal time interval : Argument , hours and minutes of sidereal interval .
Mean solar into sidereal time :	To be added to a mean time interval : Argument , hours and minutes of mean time interval .
For any stellar observation :	Amount to be subtracted from the Greenwich mean time of transit or elongation to obtain local mean time : Argument , longitude west from Greenwich ; add for longitudes east from Greenwich .

FOR FINDING THE VERTICAL AND HORIZONTAL ANGLES OF A STAR

Natural Sines, Cosines, and Tangents

For sin tan	tan		sin		For cos only
0°00'	.0000	44	.0000	44	90°00'
15'	.0044	43	.0044	43	45'
30'	.0087	44	.0087	44	30'
45'	.0131	44	.0131	44	15'
1°00'	.0175	43	.0175	43	89°00'
15'	.0218	44	.0218	44	45'
30'	.0262	44	.0262	43	30'
45'	.0306	43	.0305	44	15'
2°00'	.0349	44	.0349	44	88°00'
15'	.0393	44	.0393	43	45'
30'	.0437	43	.0436	44	30'
45'	.0480	44	.0480	43	15'
3°00'	.0524	44	.0523	44	87°00'
15'	.0568	44	.0567	43	45'
30'	.0612	43	.0610	44	30'
45'	.0655	44	.0654	44	15'
4°00'	.0699	44	.0698	43	86°00'
15'	.0743	44	.0741	44	45'
30'	.0787	44	.0785	43	30'
45'	.0831	44	.0828	44	15'
5°00'	.0875	44	.0872	43	85°00'
15'	.0919	44	.0915	43	45'
30'	.0963	44	.0958	44	30'
45'	.1007	44	.1002	43	15'
6°00'	.1051	44	.1045	44	84°00'
15'	.1095	44	.1089	43	45'
30'	.1139	45	.1132	43	30'
45'	.1184	44	.1175	44	15'
7°00'	.1228	44	.1219	43	83°00'
15'	.1272	45	.1262	43	45'
30'	.1317	44	.1305	44	30'
45'	.1361	44	.1349	43	15'
8°00'	.1405	45	.1392	43	82°00'
15'	.1450	45	.1435	43	45'
30'	.1495	44	.1478	43	30'
45'	.1539	45	.1521	43	15'
9°00'	.1584	45	.1564	43	81°00'
15'	.1629	44	.1607	43	45'
30'	.1673	45	.1650	43	30'
45'	.1718	45	.1693	43	15'
10°00'	.1763	45	.1736	43	80°00'
15'	.1808	45	.1779	43	45'
30'	.1853	46	.1822	43	30'
45'	.1899	45	.1865	43	15'
11°00'	.1944	45	.1908	43	79°00'
15'	.1989	46	.1951	43	45'
30'	.2035	45	.1994	42	30'
45'	.2080	46	.2036	43	15'
12°00'	.2126	45	.2079	43	78°00'
15'	.2171	46	.2122	42	45'
30'	.2217	46	.2164	43	30'
45'	.2263	46	.2207	43	15'
13°00'	.2309	46	.2250	42	77°00'
15'	.2355	46	.2292	42	45'
30'	.2401	46	.2334	43	30'
45'	.2447	46	.2377	42	15'
14°00'	.2493	47	.2419	43	76°00'
15'	.2540	46	.2462	42	45'
30'	.2586	47	.2504	42	30'
45'	.2633	46	.2546	42	15'
15°00'	.2679		.2588		75°00'
For sin tan	tan		cos		For cos only

For sin tan	tan		sin		For cos only
15°00'	.2679	47	.2588	42	75°00'
15'	.2726	47	.2630	42	45'
30'	.2773	47	.2672	42	30'
45'	.2820	47	.2714	42	15'
16°00'	.2867	48	.2756	42	74°00'
15'	.2915	47	.2798	42	45'
30'	.2962	48	.2840	42	30'
45'	.3010	47	.2882	42	15'
17°00'	.3057	48	.2924	41	73°00'
15'	.3105	48	.2965	42	45'
30'	.3153	48	.3007	42	30'
45'	.3201	48	.3049	41	15'
18°00'	.3249	49	.3090	42	72°00'
15'	.3298	48	.3132	41	45'
30'	.3346	49	.3173	41	30'
45'	.3395	48	.3214	42	15'
19°00'	.3443	49	.3256	41	71°00'
15'	.3492	49	.3297	41	45'
30'	.3541	49	.3338	41	30'
45'	.3590	50	.3379	41	15'
20°00'	.3640	49	.3420	41	70°00'
15'	.3689	50	.3461	41	45'
30'	.3739	50	.3502	41	30'
45'	.3789	50	.3543	41	15'
21°00'	.3839	50	.3584	40	69°00'
15'	.3889	50	.3624	41	45'
30'	.3939	51	.3665	41	30'
45'	.3990	50	.3706	40	15'
22°00'	.4040	51	.3746	40	68°00'
15'	.4091	51	.3786	41	45'
30'	.4142	51	.3827	40	30'
45'	.4193	52	.3867	40	15'
23°00'	.4245	51	.3907	40	67°00'
15'	.4296	52	.3947	40	45'
30'	.4348	52	.3987	40	30'
45'	.4400	52	.4027	40	15'
24°00'	.4452	53	.4067	40	66°00'
15'	.4505	52	.4107	40	45'
30'	.4557	53	.4147	40	30'
45'	.4610	53	.4187	39	15'
25°00'	.4663	53	.4226	40	65°00'
15'	.4716	54	.4266	39	45'
30'	.4770	53	.4305	39	30'
45'	.4823	54	.4344	40	15'
26°00'	.4877	54	.4384	39	64°00'
15'	.4931	55	.4423	39	45'
30'	.4986	54	.4462	39	30'
45'	.5040	55	.4501	39	15'
27°00'	.5095	55	.4540	39	63°00'
15'	.5150	56	.4579	38	45'
30'	.5206	55	.4617	39	30'
45'	.5261	56	.4656	39	15'
28°00'	.5317	56	.4695	38	62°00'
15'	.5373	57	.4733	39	45'
30'	.5430	56	.4772	38	30'
45'	.5486	57	.4810	38	15'
29°00'	.5543	57	.4848	38	61°00'
15'	.5600	58	.4886	38	45'
30'	.5658	57	.4924	38	30'
45'	.5715	59	.4962	38	15'
30°00'	.5774		.5000		60°00'
For sin tan	tan		cos		For cos only

For sin tan	tan		sin		For cos only
30°00'	.5774	58	.5000	38	60°00'
15'	.5832	58	.5038	37	45'
30'	.5890	59	.5075	38	30'
45'	.5949	60	.5113	37	15'
31°00'	.6009	59	.5150	38	59°00'
15'	.6068	60	.5188	37	45'
30'	.6128	60	.5225	37	30'
45'	.6188	61	.5262	37	15'
32°00'	.6249	61	.5299	37	58°00'
15'	.6310	61	.5336	37	45'
30'	.6371	61	.5373	37	30'
45'	.6432	62	.5410	36	15'
33°00'	.6494	62	.5446	37	57°00'
15'	.6556	63	.5483	36	45'
30'	.6619	63	.5519	37	30'
45'	.6682	63	.5556	36	15'
34°00'	.6745	64	.5592	36	56°00'
15'	.6809	64	.5628	36	45'
30'	.6873	64	.5664	36	30'
45'	.6937	65	.5700	36	15'
35°00'	.7002	65	.5736	35	55°00'
15'	.7067	66	.5771	36	45'
30'	.7133	66	.5807	35	30'
45'	.7199	66	.5842	36	15'
36°00'	.7265	67	.5878	35	54°00'
15'	.7332	68	.5913	35	45'
30'	.7400	67	.5948	35	30'
45'	.7467	69	.5983	35	15'
37°00'	.7536	68	.6018	35	53°00'
15'	.7604	69	.6053	35	45'
30'	.7673	70	.6088	34	30'
45'	.7743	70	.6122	35	15'
38°00'	.7813	70	.6157	34	52°00'
15'	.7883	71	.6191	34	45'
30'	.7954	72	.6225	34	30'
45'	.8026	72	.6259	34	15'
39°00'	.8098	72	.6293	34	51°00'
15'	.8170	73	.6327	34	45'
30'	.8243	74	.6361	33	30'
45'	.8317	74	.6394	34	15'
40°00'	.8391	75	.6428	33	50°00'
15'	.8466	75	.6461	33	45'
30'	.8541	76	.6494	34	30'
45'	.8617	76	.6528	33	15'
41°00'	.8693	77	.6561	32	49°00'
15'	.8770	77	.6593	33	45'
30'	.8847	78	.6626	33	30'
45'	.8925	79	.6659	32	15'
42°00'	.9004	79	.6691	33	48°00'
15'	.9083	80	.6724	32	45'
30'	.9163	81	.6756	32	30'
45'	.9244	81	.6788	32	15'
43°00'	.9325	82	.6820	32	47°00'
15'	.9407	83	.6852	32	45'
30'	.9490	83	.6884	31	30'
45'	.9573	84	.6915	32	15'
44°00'	.9657	85	.6947	31	46°00'
15'	.9742	85	.6978	31	45'
30'	.9827	86	.7009	31	30'
45'	.9913	87	.7040	31	15'
45°00'	1.0000		.7071		45°00'
For sin tan	tan		cos		For cos only

On the meridian, the vertical angle: $h = 90° - \varphi \pm \delta$

At any hour angle: $\sin h = \cos t \cos \varphi \cos \delta + \sin \varphi \sin \delta$

The product: "$\sin \varphi \sin \delta$" is negative for south declinations.

The product: "$\cos t \cos \varphi \cos \delta$" is negative for hour angles exceeding six hours or 90°.

FOR FINDING THE VERTICAL AND HORIZONTAL ANGLES OF A STAR

Natural Sines, Cosines, and Tangents

For sin tan	tan		sin		For cos only	For sin tan	tan		sin		For cos only	For sin	sin		For cos only
45°00'	1.0000	88	.7071	31	45°00'	60°00'	1.7321	175	.8660	22	30°00'	75°00'	.9659	11	15°00'
15'	1.0088	88	.7102	31	45'	15'	1.7496	179	.8682	22	45'	15'	.9670	11	45'
30'	1.0176	89	.7133	30	30'	30'	1.7675	181	.8704	21	30'	30'	.9681	11	30'
45'	1.0265	90	.7163	30	15'	45'	1.7856	184	.8725	21	15'	45'	.9692	11	15'
46°00'	1.0355	91	.7193	31	44°00'	61°00'	1.8040	188	.8746	21	29°00'	76°00'	.9703	10	14°00'
15'	1.0446	92	.7224	30	45'	15'	1.8228	190	.8767	21	45'	15'	.9713	11	45'
30'	1.0538	92	.7254	30	30'	30'	1.8418	193	.8788	21	30'	30'	.9724	10	30'
45'	1.0630	94	.7284	30	15'	45'	1.8611	196	.8809	20	15'	45'	.9734	10	15'
47°00'	1.0724	94	.7314	29	43°00'	62°00'	1.8807	200	.8829	21	28°00'	77°00'	.9744	9	13°00'
15'	1.0818	95	.7343	30	45'	15'	1.9007	203	.8850	20	45'	15'	.9753	10	45'
30'	1.0913	96	.7373	29	30'	30'	1.9210	206	.8870	20	30'	30'	.9763	9	30'
45'	1.1009	97	.7402	29	15'	45'	1.9416	210	.8890	20	15'	45'	.9772	9	15'
48°00'	1.1106	98	.7431	30	42°00'	63°00'	1.9626	214	.8910	20	27°00'	78°00'	.9781	9	12°00'
15'	1.1204	99	.7461	29	45'	15'	1.9840	217	.8930	19	45'	15'	.9790	9	45'
30'	1.1303	100	.7490	28	30'	30'	2.0057	221	.8949	20	30'	30'	.9799	9	30'
45'	1.1403	101	.7518	29	15'	45'	2.0278	225	.8969	19	15'	45'	.9808	8	15'
49°00'	1.1504	102	.7547	29	41°00'	64°00'	2.0503	229	.8988	19	26°00'	79°00'	.9816	9	11°00'
15'	1.1606	102	.7576	28	45'	15'	2.0732	233	.9007	19	45'	15'	.9825	8	45'
30'	1.1708	104	.7604	28	30'	30'	2.0965	238	.9026	19	30'	30'	.9833	7	30'
45'	1.1812	106	.7632	28	15'	45'	2.1203	242	.9045	18	15'	45'	.9840	8	15'
50°00'	1.1918	106	.7660	28	40°00'	65°00'	2.1445	247	.9063	18	25°00'	80°00'	.9848	8	10°00'
15'	1.2024	107	.7688	28	45'	15'	2.1692	251	.9081	19	45'	15'	.9856	7	45'
30'	1.2131	108	.7716	28	30'	30'	2.1943	256	.9100	18	30'	30'	.9863	7	30'
45'	1.2239	110	.7744	27	15'	45'	2.2199	261	.9118	17	15'	45'	.9870	7	15'
51°00'	1.2349	111	.7771	28	39°00'	66°00'	2.2460	267	.9135	18	24°00'	81°00'	.9877	7	9°00'
15'	1.2460	112	.7799	27	45'	15'	2.2727	271	.9153	18	45'	15'	.9884	6	45'
30'	1.2572	113	.7826	27	30'	30'	2.2998	278	.9171	17	30'	30'	.9890	7	30'
45'	1.2685	114	.7853	27	15'	45'	2.3276	283	.9188	17	15'	45'	.9897	6	15'
52°00'	1.2799	116	.7880	27	38°00'	67°00'	2.3559	288	.9205	17	23°00'	82°00'	.9903	6	8°00'
15'	1.2915	117	.7907	27	45'	15'	2.3847	295	.9222	17	45'	15'	.9909	5	45'
30'	1.3032	119	.7934	26	30'	30'	2.4142	301	.9239	16	30'	30'	.9914	6	30'
45'	1.3151	119	.7960	26	15'	45'	2.4443	308	.9255	17	15'	45'	.9920	5	15'
53°00'	1.3270	122	.7986	27	37°00'	68°00'	2.4751	314	.9272	16	22°00'	83°00'	.9925	6	7°00'
15'	1.3392	122	.8013	26	45'	15'	2.5065	321	.9288	16	45'	15'	.9931	5	45'
30'	1.3514	124	.8039	25	30'	30'	2.5386	329	.9304	16	30'	30'	.9936	5	30'
45'	1.3638	126	.8064	26	15'	45'	2.5715	336	.9320	16	15'	45'	.9941	4	15'
54°00'	1.3764	127	.8090	26	36°00'	69°00'	2.6051	344	.9336	15	21°00'	84°00'	.9945	5	6°00'
15'	1.3891	128	.8116	25	45'	15'	2.6395	351	.9351	16	45'	15'	.9950	4	45'
30'	1.4019	131	.8141	25	30'	30'	2.6746	360	.9367	15	30'	30'	.9954	4	30'
45'	1.4150	131	.8166	26	15'	45'	2.7106	369	.9382	15	15'	45'	.9958	4	15'
55°00'	1.4281	134	.8192	24	35°00'	70°00'	2.7475	377	.9397	15	20°00'	85°00'	.9962	4	5°00'
15'	1.4415	135	.8216	25	45'	15'	2.7852	387	.9412	14	45'	15'	.9966	3	45'
30'	1.4550	137	.8241	25	30'	30'	2.8239	397	.9426	15	30'	30'	.9969	4	30'
45'	1.4687	139	.8266	24	15'	45'	2.8636	406	.9441	14	15'	45'	.9973	3	15'
56°00'	1.4826	140	.8290	25	34°00'	71°00'	2.9042	417	.9455	14	19°00'	86°00'	.9976	3	4°00'
15'	1.4966	142	.8315	24	45'	15'	2.9459	428	.9469	14	45'	15'	.9979	2	45'
30'	1.5108	145	.8339	24	30'	30'	2.9887	439	.9483	14	30'	30'	.9981	3	30'
45'	1.5253	146	.8363	24	15'	45'	3.0326	451	.9497	14	15'	45'	.9984	2	15'
57°00'	1.5399	148	.8387	23	33°00'	72°00'	3.0777	463	.9511	13	18°00'	87°00'	.9986	2	3°00'
15'	1.5547	150	.8410	24	45'	15'	3.1240	476	.9524	13	45'	15'	.9988	2	45'
30'	1.5697	152	.8434	23	30'	30'	3.1716	489	.9537	13	30'	30'	.9990	2	30'
45'	1.5849	154	.8457	23	15'	45'	3.2205	504	.9550	13	15'	45'	.9992	2	15'
58°00'	1.6003	157	.8480	24	32°00'	73°00'	3.2709	517	.9563	13	17°00'	88°00'	.9994	1	2°00'
15'	1.6160	159	.8504	22	45'	15'	3.3226	533	.9576	12	45'	15'	.9995	2	45'
30'	1.6319	160	.8526	23	30'	30'	3.3759	549	.9588	12	30'	30'	.9997	1	30'
45'	1.6479	164	.8549	23	15'	45'	3.4308	566	.9600	13	15'	45'	.9998	0	15'
59°00'	1.6643	165	.8572	22	31°00'	74°00'	3.4874	583	.9613	12	16°00'	89°00'	.9998	1	1°00'
15'	1.6808	169	.8594	22	45'	15'	3.5457	602	.9625	11	45'	15'	.9999	1	45'
30'	1.6977	170	.8616	22	30'	30'	3.6059	621	.9636	12	30'	30'	1.0000	0	30'
45'	1.7147	174	.8638	22	15'	45'	3.6680	641	.9648	11	15'	45'	1.0000	0	15'
60°00'	1.7321		.8660		30°00'	75°00'	3.7321		.9659		15°00'	90°00'	1.0000		0°00'
For sin tan	tan		cos		For cos only	For sin tan	tan		cos		For cos only	For sin	cos		For cos only

The horizontal angle may be found from the equation: $\text{Cos A} = \frac{\sin\delta}{\cos\varphi\cos h} - \tan\varphi\tan h$

"Sin δ" is negative for south declinations.

If the result for "cos A" is $\left\{\begin{matrix}\text{positive}\\ \text{negative}\end{matrix}\right\}$ the horizontal angle counts from the $\left\{\begin{matrix}\text{north.}\\ \text{south.}\end{matrix}\right.$

PREPARING FOR THE OBSERVATIONS

The modern solar transit, as developed for surveying the public lands, affords a ready determination of the factors of time, latitude, and azimuth, which are the starting values employed in the stellar observations. The latter are designed to supply the desired refinements in the values, better than the limits of the solar unit. A carefully determined meridian is used in making the instrumental adjustments and tests, preliminary to the running of the lines, and the direction of the latter is verified at frequent intervals.

Since few solar transits are in general use, consideration is to be given to the preliminary steps to be taken when the factors of time, latitude, and azimuth are unknown, or are only roughly approximate. If nothing is to be assumed as known, or approximate, it is well to begin with the equal-altitude observation on the sun, or one of the known bright stars, by which the latitude, azimuth, and time may all be derived.

If the uncertainty in latitude is not more than 2′ or 3′, an altitude observation of the sun, or any known bright star, may be made, from which to derive preliminary values for time and azimuth, using the approximate latitude as the factor until its value can be suitably corrected. An observation of Polaris at elongation may be made without exact data as to the time or latitude.

An interpretation of the terms "approximate" and "rough" may be helpful in clarifying what is intended. These terms have been used with reference to the preliminary values for time, latitude, and azimuth, to be regarded as more or less reliable for the identification of a star by vertical and horizontal angles. For this purpose and for a starlight period, a rough estimate based upon incomplete data, employed with good judgment, may allow a fairly wide tolerance and yet be entirely acceptable for the identification of a star without the slightest doubt. However, if a daylight or twilight observing period is proposed the setting positions should be sufficiently good to bring the star within the middle-third of the telescope. The time of passage across the field is slightly more than 4 minutes.

Some practice in making the observations by starlight is needed, or will be helpful, before making the twilight or daylight observations, and for the latter it is desirable to prepare the data for several positions for the sequence of settings at intervals that will allow for the reading of angles and the instrumental reversals. Obviously, the twilight or daylight observation will depend very largely upon the clearness of the atmosphere.

In all cases the finding positions are for the identification of a star, and having served that purpose the observation proceeds with the required care in all detail. The arrangement of the data and the suggestions as to the observing plan are intended to simplify the steps. The methods for a well-balanced observing program are good for results within ± 6 seconds of time; ± 15″ in latitude and azimuth; for vernier readings to the nearest 30″; due care being given to the necessary refinements in the observing and in the reductions; these limits are with reference to the one-minute transit ordinarily supplied to the field parties.

The setting positions for the instrument, in vertical angle (v or h for this purpose), and in horizontal angle (A) counting from the meridian (or from an approximate north and south line) are derived from the equations after having determined the hour angle (t) for the anticipated moment for the observation.

The 4-place tables may be used to shorten the work, as being sufficient for the star's identification or finding.

Example.

Star: 6-10 1.1
α Tauri (Aldebaran)
δ : +16°26′

$\sin h = \cos t \cos \varphi \cos \delta + \sin \varphi \sin \delta$

	cos	sin
t =	.330	
φ =	.816	.578
δ =	.959	.283
	.2582	.1636 (Products)
		.2582
sin h =		.4218 (Sum)
h =	24°57′	

φ : Approximate latitude: 35°18′

t : Anticipated hour angle: $4^h 43^m$ (70°45′)

$$\cos A = \frac{\sin \delta}{\cos \varphi \cos h} - \tan \varphi \tan h$$

	cos	sin	tan
	.816		.708
		.283	
	.907	____	.465
	.7401		.3292 (Products)
		.3824	.3824 (Fraction)
cos A =			.0532 (Diff. +)

A = 86°57′ (Counting from the north)

In general make each reading to the nearest third place, regarding the values as merely approximate. The results are good as finding positions, or for the star's identification. The true values are obtained by careful reduction of the observations.

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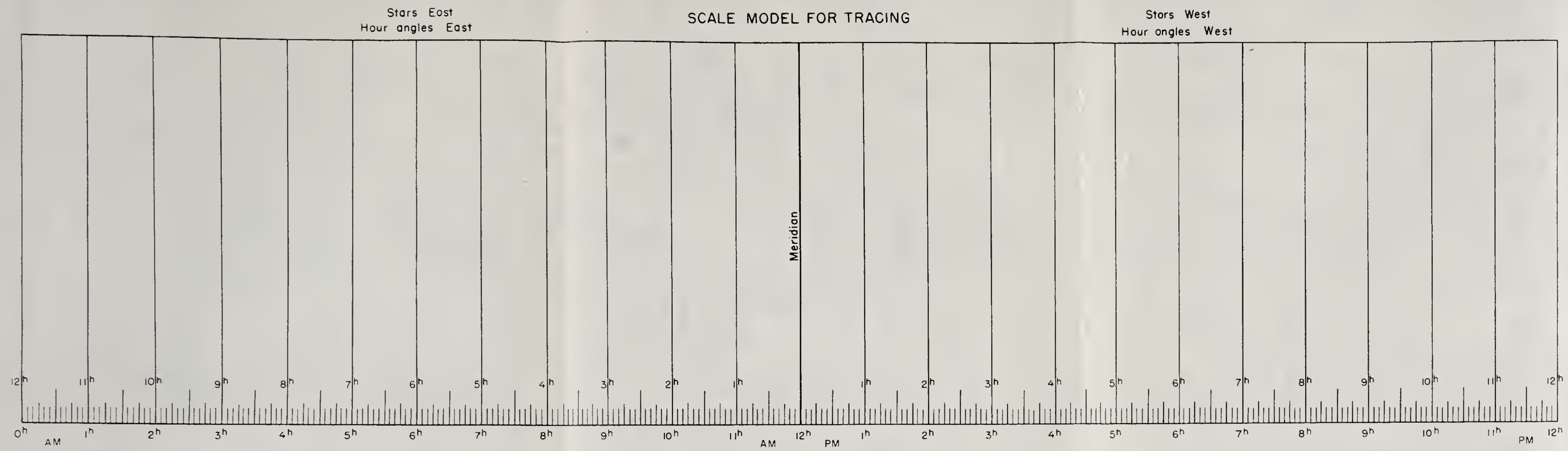
SCALE MODEL FOR TRACING


Stars East
Hour angles East
Stars West
Hour angles West
Meridian
12h 11h 10h 9h 8h 7h 6h 5h 4h 3h 2h 1h 1h 2h 3h 4h 5h 6h 7h 8h 9h 10h 11h 12h
0h AM 1h 2h 3h 4h 5h 6h 7h 8h 9h 10h 11h AM 12h PM 1h 2h 3h 4h 5h 6h 7h 8h 9h 10h 11h PM 12h

Upper set of figures for hour angles.
Lower set of figures for anticipated local mean time of observation.
Match the mark for the anticipated local mean time of observation with the mark for the date.

THE STAR CHART

The chart visualizes the positions of the selected stars. The right ascension is expressed in hours of sidereal time, from west to east, counting from the point where the path of the sun in its northward course in declination crosses the equator. The point is termed the vernal equinox.

The sidereal day of 24 hours is approximately 4 minutes shorter than the ordinary mean solar day; a star will cross the meridian approximately 4 minutes earlier each succeeding day; on one calendar day each year a star will have a double meridian passage.

The chart is to be oriented facing south. The center of the field at noon on any date may be interpolated (roughly) between the marks for the dates as indicated. At 6 p. m., local mean time, the center of the field, or line for the meridian, will be six hours to the left; at 8 p. m., 8 hours to the left; both counting from the point for the noon of the date.

The interval between the time of a star's meridian passage and any other position in its diurnal circle is the star's sidereal hour angle, at the moment, and may count either to the east or to the west.

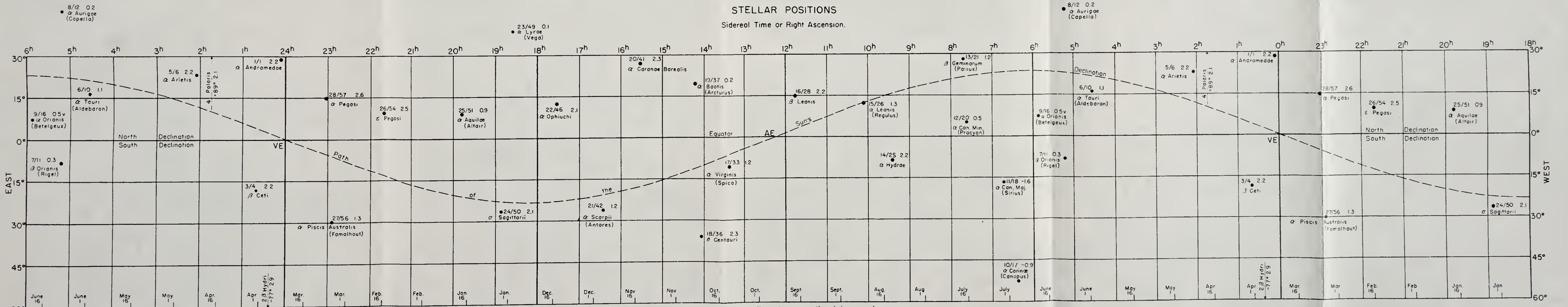
Anticipating the local mean time of an observation, a star's hour angle, at that moment, may be scaled (roughly) according to its position on the diagram to the east or to the west of the line for the meridian as placed for that date and time.

The calculations for the reduction of an observation are to be based upon the exact local mean time of the star's meridian passage for the date as ascertained from the tabulated data, from which the sidereal interval, or hour angle at the moment of the observation, may be derived, and the latter converted into the equivalent mean time interval.

It may be noted that the time factor does not enter into the equation for azimuth in the reduction of an altitude observation.

STELLAR POSITIONS

Sidereal Time or Right Ascension.



Referred to the meridian of noon on the dates as shown.

672144 O - 63 (Face p. 30)

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